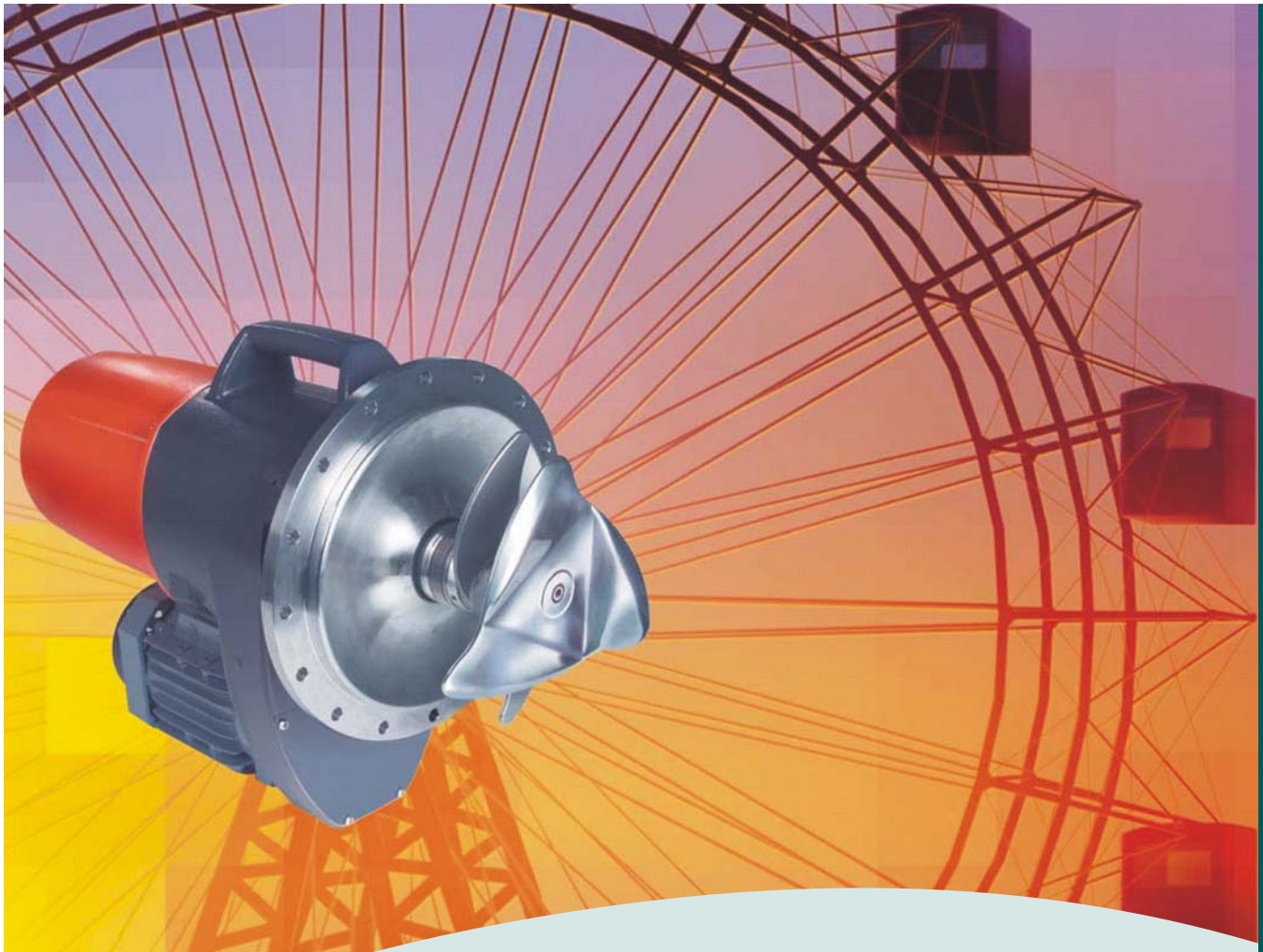

kajaani

kajaaniROTARY™

Installation, operating & service manual

T00358EN Ver. A

- for version A ->

metso automation

Caution / Warning

During installation, maintenance and service operations, remember that the sample line may contain hot sample or water - be careful!

Always check that the incoming voltage and frequency are correct before making any electric connections. Wrong connection may damage the equipment! The applicable electrical safety regulations must be closely followed in all installation work! All electrical connections can be done only by authorized persons!

Before any welding works in the vicinity of the devices, make sure that operating voltage is not connected!

The samplers contain moving parts. DANGER! Be careful when testing the sampler! Do not push your fingers between any moving parts!

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1. Introduction

1.1. kajaaniROTARY consistency transmitter

The kajaaniROTARY, a rotating consistency transmitter based on force balance principle, measures the shear force induced torque generated by the pulp fiber network. The transmitter consists of a shaft pair driven by an electric motor. This shaft pair comprises of two concentrically aligned, flexibly connected shafts where the inner (measuring) shaft is allowed to have a phase shift with respect to the outer (drive) shaft.

The rotation of a mixing propeller, mounted on the drive shaft, draws a continuous sample from the main process line past the sensing element, mounted on the measuring shaft. The rotation of the sensing element in the pulp is restricted by a given torque which strives to retard the measuring shaft in relation to the drive shaft.

The phase shift is measured optically from toothed wheels connected to the shafts. The measured signal is then converted in the transmitter electronics into a digital feedback signal to adjust the electromagnetic counterbalance force. The electromagnetic field is created by two coils that induce a magnetic field of the polarity into the torque wheels connected to the shaft.

The strength of the electromagnetic force is adjusted by a controller to give a fixed setpoint value for the phase shift measurement. The value of the current fed into the coils is converted into torque and further into consistency. The signal is then converted to a 4–20 mA output signal with a superimposed digital HART®.

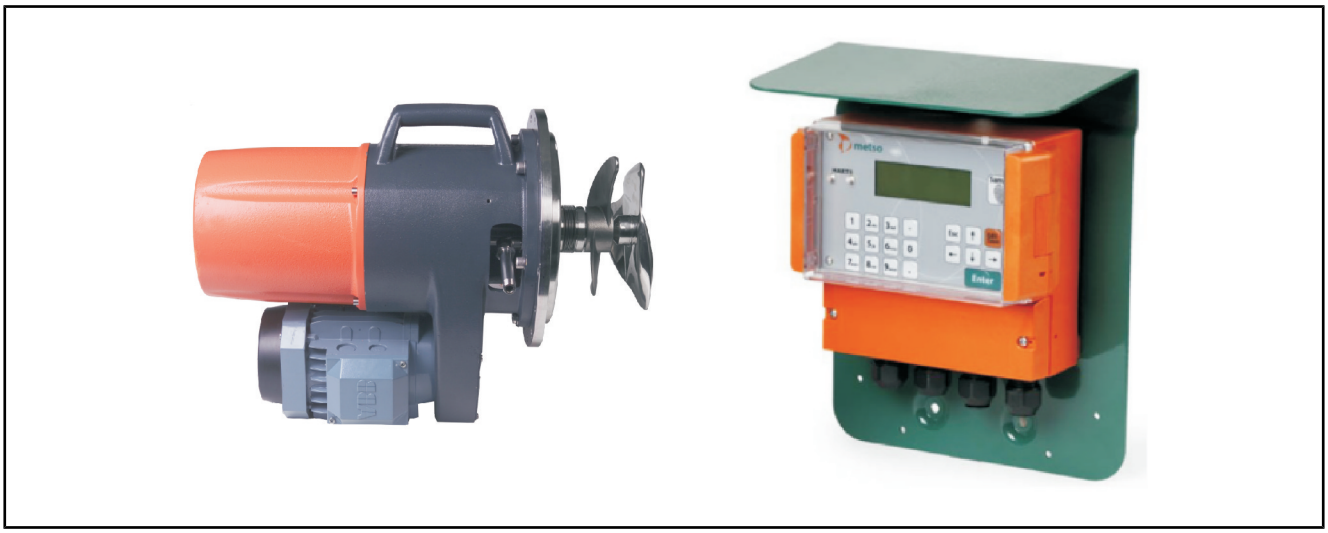


Figure 1.1. kajaaniROTARY transmitter and TCU.

1.2. Conformity to CE directives and CSA approval

The entire system, consisting of a TCU with power supply, the transmitter, the connecting cables (see chapter 4. TCU installation and cabling), has been designed to meet the following CE directives and their associated standards:

- Machine Directive 93/44EEC
- PED Directive 97/23/EEC
- EMC Directive 89/336/EEC
- Low voltage directive 73/23/EEC

In order to meet the EMC directive, the following precautions must be taken:

1. All wiring must be shielded. Power supply electronics: shielded, coverage ≥ 80%. Interface cable: coverage 100% aluminum.
2. All units have been tested as a complete system to conform with the relevant CE directives and their standards.

When the units are used in other combinations, Metso cannot guarantee their CE directive conformity. In combination with customer-installed external devices, the units may conform to EMC and safety requirements when properly installed and using an adequate CE marked equipment.

NOTE: System operator is responsible for the CE directive conformity. Conformity must be checked by inspection.

- Be careful when handling the equipment in connection with vessels containing pressurized/hot materials.
- Take the necessary safety precautions when mounting the equipment by using appropriate lift gear, platforms and tools.
- The motor and TCU are powered by hazardous voltages.

The TCU box is CSA approved. The transmitter motor can be ordered as CSA approved.

1.3. Basic transmitter dimensions

The dimensions of the kajaaniROTARY transmitter are given in figure 1.2.

NOTE: Always ensure that the system can be inserted to its full depth in the selected location before you install the transmitter, TCU and necessary components.

The length of the transmitter, including sensor and propeller, is approximately 510 mm (20"). The installed length of the transmitter is 385 mm (15"), and there must be at least an additional 150 mm (6") room for extracting the transmitter from the pulp line. Make sure to leave sufficient room around the transmitter to perform this task. The transmitter weighs approximately 36 kg (80 lbs).

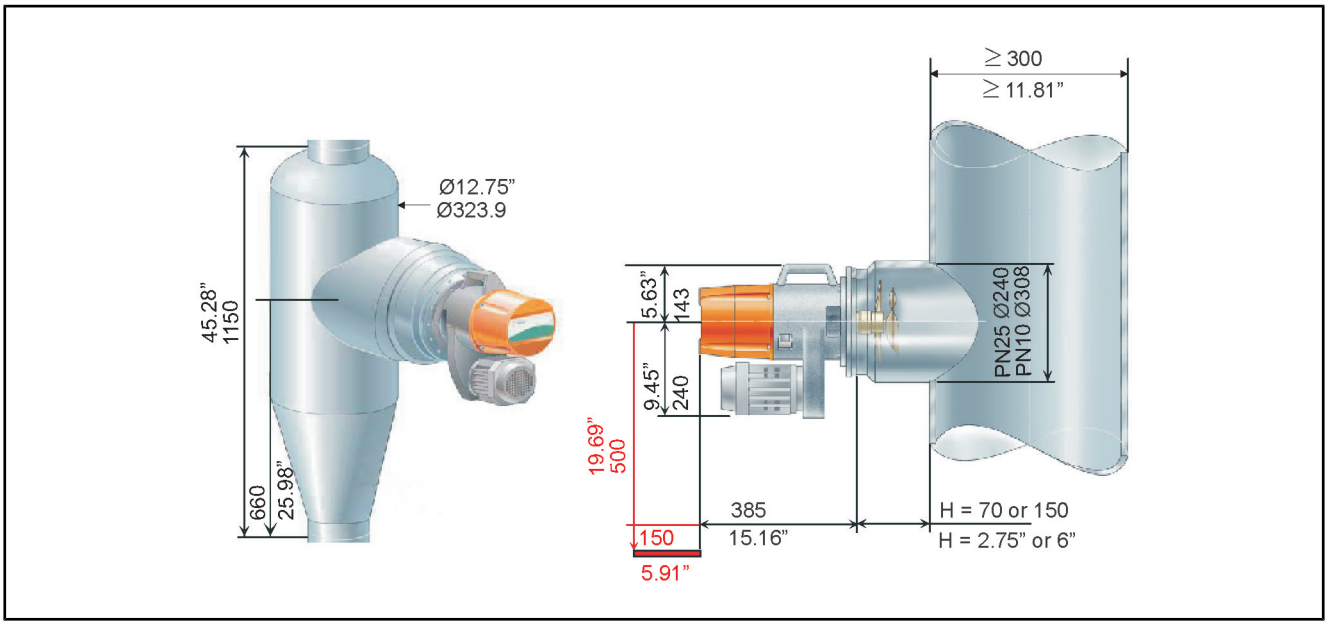


Figure 1.2. The dimensions of the kajaaniROTARY transmitter.

1.4. TCU

TCU is the user interface, power supply and calculation unit of kajaaniROTARY. Operations are performed by using the TCU's keys and four-line display. The TCU is delivered attached to the shield.

The TCU has the following connectors:

- For the sensor unit, sensor electronics supply voltage and RS485 serial port connectors.
- For the 4 - 20 mA current output (passive) to DCS.
- For digital communication using HART communication protocol.
- For RS232 connection to a PC (for maintenance purposes).
- For mains supply voltage.

NOTE: Use TCU version OUL00377 with kajaaniROTARY. See Appendix 2 - Delivery content.

1.5. Materials

All the materials used in the exposed surfaces of the kajaaniROTARY system are selected and manufactured for use in pulp and paper mill environments. The system cable is sheathed in PVC. The transmitter housing is made of cast aluminum painted with epoxy-poly urethan paint.

Materials used in the wetted parts of the transmitter, i.e. the transmitter itself, its mounting chamber (if used) and process coupling, must be selected according to the process conditions. Alternative materials: stainless steel AISI316L, 254 SMO® or Hastelloy C-276.

2. Safety recommendations

These safety recommendations are based on a risk analysis carried out in accordance with the requirements of the machinery and low voltage directives in order to comply with European standards for CE marking. For the CE Declaration of conformity, see Appendix 5.

Read carefully all safety recommendations and instructions before installing any parts of the delivery.

2.1. General

In practice, an operating consistency transmitter poses a risk due to moving machine parts or hazardous voltages only when its covers have been removed for installation or service operations.

Be sure to follow precisely the instructions and recommendations when installing, connecting, or servicing the transmitter. These safety recommendations apply to a transmitter installed with an AC-powered TCU.

The mounting parts, e.g. mounting chamber and process coupling, have been manufactured by Metso in accordance with the EU's Pressure Equipment Directive, PED.

NOTE: Do not use any other parts except those that are manufactured or approved by Metso Automation. Follow valid instructions and standards during installation.

2.2. Selecting the transmitter model and assembly parts

The pressure rating of the transmitter and its mounting parts must be suited to the current maximum pipe pressure and temperature. Select the material of the transmitter and its mountings parts so as to minimize the risk of corrosion. (See Appendix 1, Technical specifications).

2.3. Installing the mounting parts

Welding or bolting and the subsequent inspection must take place in accordance with the valid standards and regulations.

For safety reasons, only use approved lifting equipment during installation. Fasten all parts well during installation. The mounting chamber weighs approximately 40 kg (88 lb).

Before installing any mounting parts, make sure that the pipe is empty and depressurized!

2.4. Installing and connecting the transmitter

See the installation instructions in chapter 3.

- Use approved lifting equipment during installation. Ensure that the transmitter is fastened properly. (The transmitter weighs approximately 40 kg / 88 lb.)
- If the transmitter is located high up, construct proper scaffolding.
- When the transmitter has been installed, make a pressure test using water in the pipeline. The test pressure is adapted to standards and regulations in each country.

High voltage motor! The connection must be made by authorized personnel.

The electric motor uses a hazardous voltage. Only a qualified electrician may connect the motor. Follow the instructions closely! Make sure to connect the motor earth correctly; double-check after connecting.

2.5. Installing TCU

The TCU uses a hazardous voltage. Only a qualified electrician may connect the TCU. Make sure to connect the earth correctly, double-check after connecting.

High voltage inside the TCU!

2.6. Starting up and servicing the transmitter

Before starting or servicing the transmitter, study carefully the instructions in chapter 3. Do not remove any covers before ensuring that the transmitter motor is switched off. When the safety covers on the motor's drive belt wheel or on the measuring parts are removed, there is a risk of injury by crushing or cutting.

NOTE: Take all professional precautions before servicing.

Before removing the transmitter from the process line, make sure that the line is empty and depressurized.

NOTE: Hot or corrosive liquids may flow out under pressure – risk of serious chemical burn injuries!

Be careful when opening the TCU cover. The unit contains live parts that may cause electric shocks. If the connections have been made correctly, the live parts are protected against normal contact.

Transmitters located in corrosive applications should be removed regularly from the process line and their seals and other critical parts inspected carefully. If corrosion damage is observed on the transmitter or its mounting parts, ensure that correct material has been selected for the application.

NOTE: Leakage may cause personal injury or equipment damage due to corrosion or burning!

Moving the covers may cause the injury of crushing or cutting.

3. Transmitter installation

3.1. Acceptance inspection

Do not remove the cover.

1. Make sure that the delivery content corresponds to the order.
2. Check the device for possible transport damage.

3.2. Before you begin

kajaaniROTARY is a precision instrument and it must be installed correctly to ensure reliable operation. Prior to the installation of the transmitter, please read the following instructions. This instruction manual contains installation instructions for the entire product line of Metso in-line rotating consistency transmitters.

The transmitter had been designed and manufactured to provide accurate and reliable measurements throughout its entire lifetime.

NOTE: Correct installation and regular maintenance according to the Installation, operating & service manual will ensure maximum use transmitter capacity.

- Install the transmitter so that it is protected from direct mechanical damage. If the place is such that it is likely to be frequently sprayed by water or pulp, protect it with a suitable enclosure.
- The TCU must be attached to the shield (included in every delivery) to protect it from water or pulp splashes. If the TCU is installed outdoors, the shield will also protect it from direct sunlight and rain.
- Protect the transmitter from heavy vibration sources, such as cavitation or unbalanced pumps.
- Install the transmitter in such a place that it is at the required distance from pumps, pipe elbows, valves and other changes in the pipe profile.
- The type and material of the mounting chamber, weld-in process coupling, sensing element, propeller, etc. must be selected according to the requirements of each application to ensure PED conformity. Contact your Metso representative for further information.
- Use good quality sealing water as the flushing water for the mechanical seal. Make sure that the flushing/sealing water pressure is maintained at all times. See figure 3.10.
- The main power voltage & frequency must be within acceptable limits and be protected against transient disturbance sources, such as other equipment or electrical storms.
- Make sure that the signal cables are located far away from the power cables.
- If the transmitter must be installed high up or in a place where it will be difficult to reach, a platform should be constructed to provide easy access during service and inspection. A platform is also a good solution for positioning the sampling valve.
- Install a Nove sampling valve close to the transmitter. This will ensure that the samples will be representative of the sample measured by the consistency transmitter.
- Reserve enough space for the sensor casing; see figure 1.2. Also pay attention to the limits given in Appendix 1, Technical specifications.

This manual contains instructions for the planning and implementation of kajaaniROTARY in-line consistency transmitter installation. The kajaaniROTARY is highly specialized transmitter optimized for several individual application ranges.

NOTE: If you are in doubt about whether the model you plan to install is in all respects the same as the model in this manual, or if you have any questions about the installation, please contact your Metso sales engineer.

3.3. Selecting the mounting location

Choosing the right place for the transmitter is essential for its optimum performance and ease of maintenance. The transmitter can be installed in a vertical, horizontal or inclined pipe. When installing in a horizontal or inclined pipe, make sure to choose a place where the transmitter will not measure large bubbles trapped in the pulp. The mounting chamber used in low-pressure installations may be left-handed or right-handed in design.

Figures 3.1 and 3.4 show typical installations. Your Metso sales engineer will be pleased to assist in selecting the location that will give the best results consistent with your specific control strategy.

Pay attention to the following considerations:

1. To ensure minimum time lag, install the transmitter as close as possible to the dilution water injection point.
2. Recommended minimum distances: see figures 3.1 and 3.4.
3. Avoid proximity to pipe bends or elbows, as these will cause turbulence and dewatering. When the transmitter is positioned downstream from a pump or a pipe elbow, the optimum place is at the theoretical outer turn of the pulp stream. If the optimum position cannot be chosen, for example due to space limitations, consult a Metso sales engineer.
4. If the transmitter will be installed so high up that it will be difficult to reach, build a platform for easier access during service and inspection.
5. Choose a location with sufficient room around the transmitter for insertion and removal and for opening the covers. The total length of the transmitter is 510 mm (20"). Make sure that the transmitter can be inserted and removed without problems.
6. Install the transmitter so that it is protected from direct mechanical damage. If the place is such that it is likely to be frequently sprayed by water or pulp, protect it with a suitable enclosure.
7. Protect the transmitter from heavy vibration such as cavitation or unbalanced pumps. One possible method is to install rubber bellows to the line.

3.4. Low pressure pipe installations

The transmitter is usually installed in a vertical pipe, downstream from a pump mixing dilution water into the pulp. To minimize the time lag after dilution, the transmitter should always be installed as close as possible to the water injection point.

Where the pressure is < 10 bar at 20 C (150 psi at 68 F), defined as PN10, and the pipe diameter is < 300 mm (10"), the transmitter should be connected to the pulp line with a mounting chamber. See Fig 3.1.

Where the pressure is < 10 bar at 20 C (150 psi at 68 F) and the pipe diameter is ≥ 300 mm (12"), the transmitter should be connected to the pulp line with a process coupling. See Technical specifications.

3.4.1. Installation of mounting chamber

Standard mounting chambers are designed for a welded connection. Flanged mounting chambers are available on request. Typical installations are shown in figure 3.1. Check the free space requirements; see figure 1.2.

Installing

1. Turn the chamber so that the flow direction arrow points in the actual direction of the pulp flow.
2. When welding, use a full penetration weld. If flange mounted, align the chamber and any gaskets before welding it to its process coupling joining the flanges.
3. Fit the 8 mm guide bolt into the upper hole in the transmitter flange, and lock it in position with thread sealant.
4. If the transmitter (and any optional sampling valve) will not be installed immediately, install a closing flange instead. Closing flanges are available from Metso.

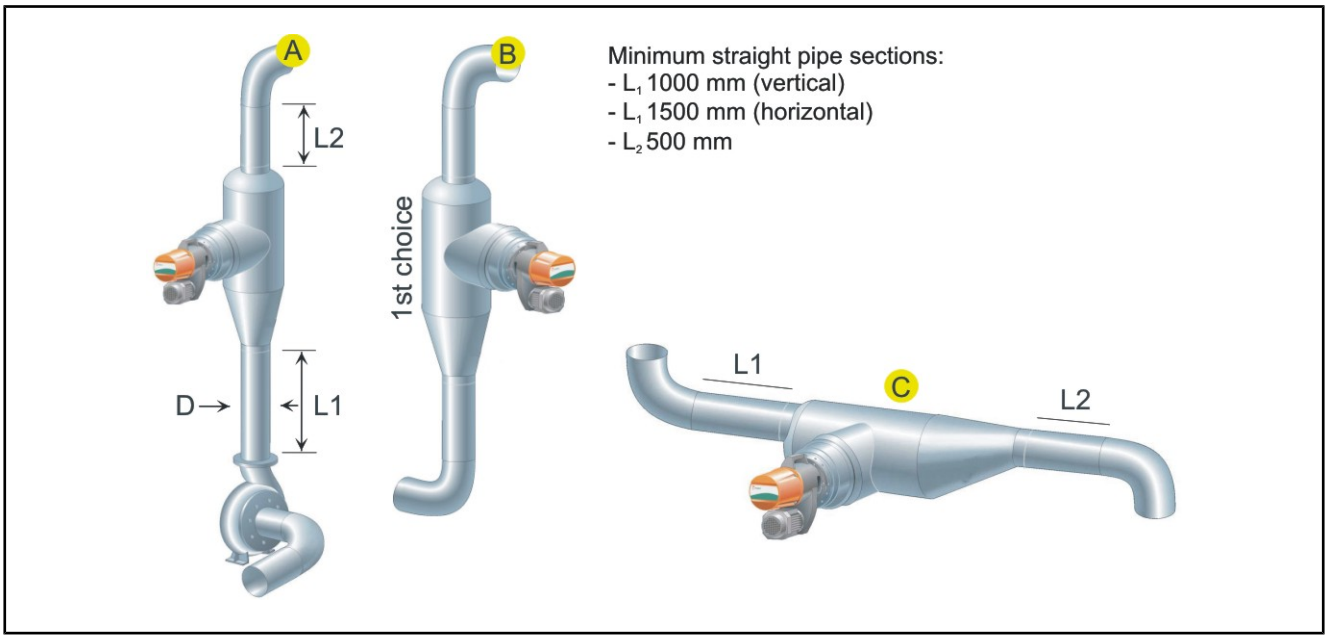


Figure 3.1. Installation to < DN300 pipes.

3.4.2. Installation with process coupling

Prior to installation, check that the pipe wall is thick enough for the required pressure rating (see figure 3.3). The length of the mounting chamber (H) may be either 70 or 150 mm (2.75” or 6") according to consistency. Always make sure that this dimension agrees with the dimension stated for the position number and in the order copy. The dimension is also stated on the process coupling. See figure 3.2 for the process coupling for PN10.

Installing

1. Cut a hole with a 308 mm (11.81") diameter in the pipe, and grind and bevel the edge to receive the weld.
2. In installations where the length of the process coupling is 70 mm (2.75"), weld deflector plates to the pipeline, upstream from the process coupling, to protect the sensing element. Install three deflector plates with the sharp ends facing upstream (see figure 3.2). New deflector plates can be made according to the picture (see figure 3.2) to replace any lost ones. To install the plates, cut 3 slots to the pipe and weld the plates into place. Note that the deflector plates have 5 mm holes to facilitate installation.
3. Compare the process coupling and the pipe dimensions and pay attention to the mounting chamber dimension “H” to make sure that no part of the process coupling extends into the pulp line.
4. To check, insert the process coupling into the hole in the pipe and mark it with a marking pen. Observe that the holes for the transmitter retaining screw should be aligned with the vertical line.
5. After profiling, weld the process coupling into the hole. Use a full penetration weld.

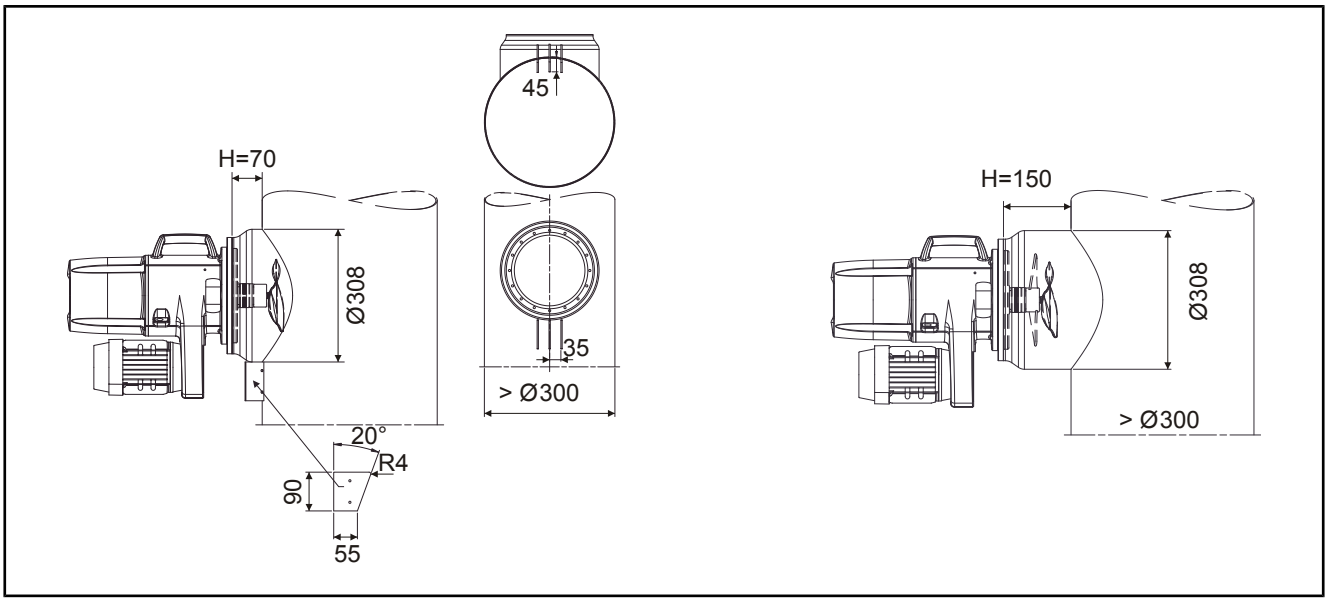


Figure 3.2. Process coupling 70 or 150 mm (2.75" or 6"), PN10.

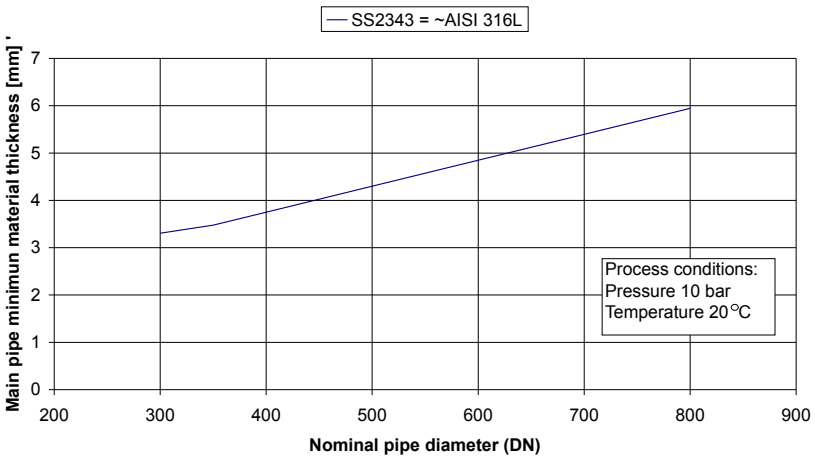


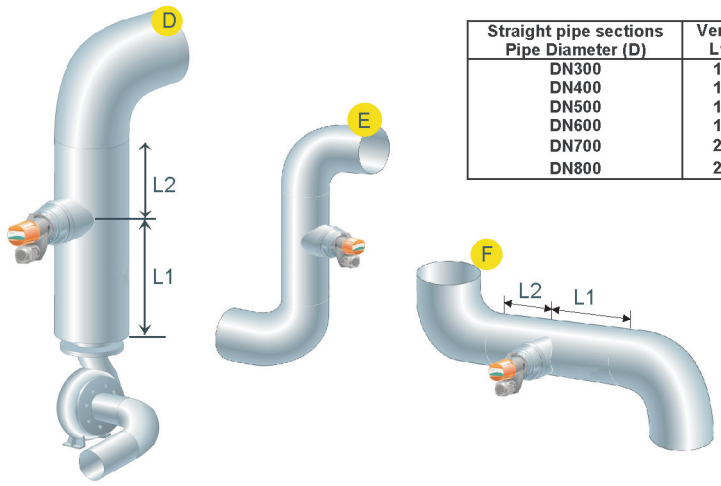
Figure 3.3. Sufficient pipe wall thickness for the required pressure rating (PN10).

Calculation parameters:
Outer diameter 308 mm
Material thickness 5 mm
Temperature = 20 C
Smax = 147 N/mm2

If the process line material thickness is close to the value given in the diagram, use a valid standard for exact calculations. The calculations must include the manufacturing tolerance of the selected pipe.

If the diagram or calculations reveal that the wall of the existing pipe is not thick enough, the pipe must be strengthened. The strengthened pipe section must extend at least 300 mm/12" on both sides of the process coupling.

Typical installations for DN300 pipes are shown in figure 3.4.



Straight pipe sections Pipe Diameter (D)	Vertical installation L1 min	Vertical installation L2 min	Horizontal installation L1 min	Horizontal installation L2 min
DN300	1000	500	1500	500
DN400	1200	600	1800	900
DN500	1500	750	2250	1125
DN600	1800	900	2700	1350
DN700	2100	1050	3150	1575
DN800	2400	1200	3600	1800

Figure 3.4. Required lengths of straight pipe around the process coupling.

3.5. High pressure pipe installations

Where the pressure is > 10 bar at 20 C (150 psi at 68 F) and the pipe diameter is ≥ DN200 (12"), the transmitter should be connected to the pulp line with process coupling PN25. See figure 3.9.

Prior to installation, check that the pipe wall is thick enough for the required pressure rating (see figures 3.7 and 3.8). The length of the mounting chamber (H) may be either 70 or 150 mm (2.75 or 6") according to consistency. Always make sure that this dimension agrees with the dimension stated for the position number and in the order copy. The dimension is also stated on the process coupling.

Installing

1. Cut a hole with a 220 mm (8.66") diameter in the pipe, and grind and bevel the edge to receive the weld.
2. In installations where the length of the process coupling is 70 mm (2.75 "), the three deflector rails supplied should be welded upstream of the process coupling, with their sharp ends facing upstream (see figures 3.5 and 3.6) to protect the sensing element. New deflector plates can be made according to pictures (see figures 3.5 and 3.6) to replace any lost one. To install the deflector plates, cut 3 slots in the pipe and weld the plates into place. Note that the deflector plates have 5 mm holes to facilitate with the installation.
3. Compare the process coupling and dimensions of the main pipeline. The supplied process coupling profiling tool sticker is recommended as a guide for profiling.
4. After profiling, weld the process coupling to the hole (see figures 3.5 and 3.6). A full penetration weld must be used.

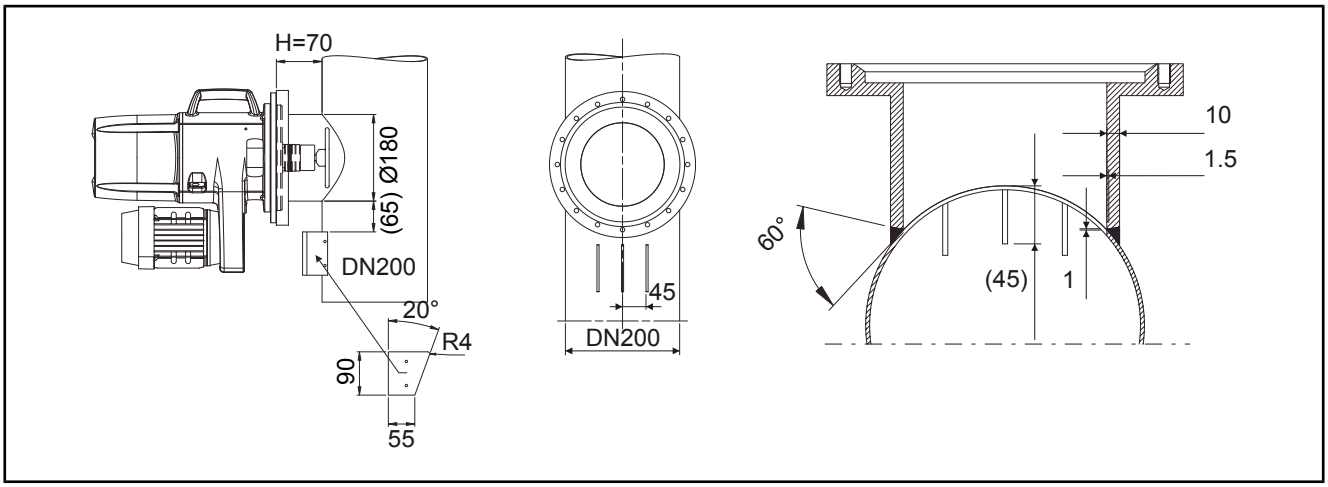


Figure 3.5. Process coupling for DN200, PN25.

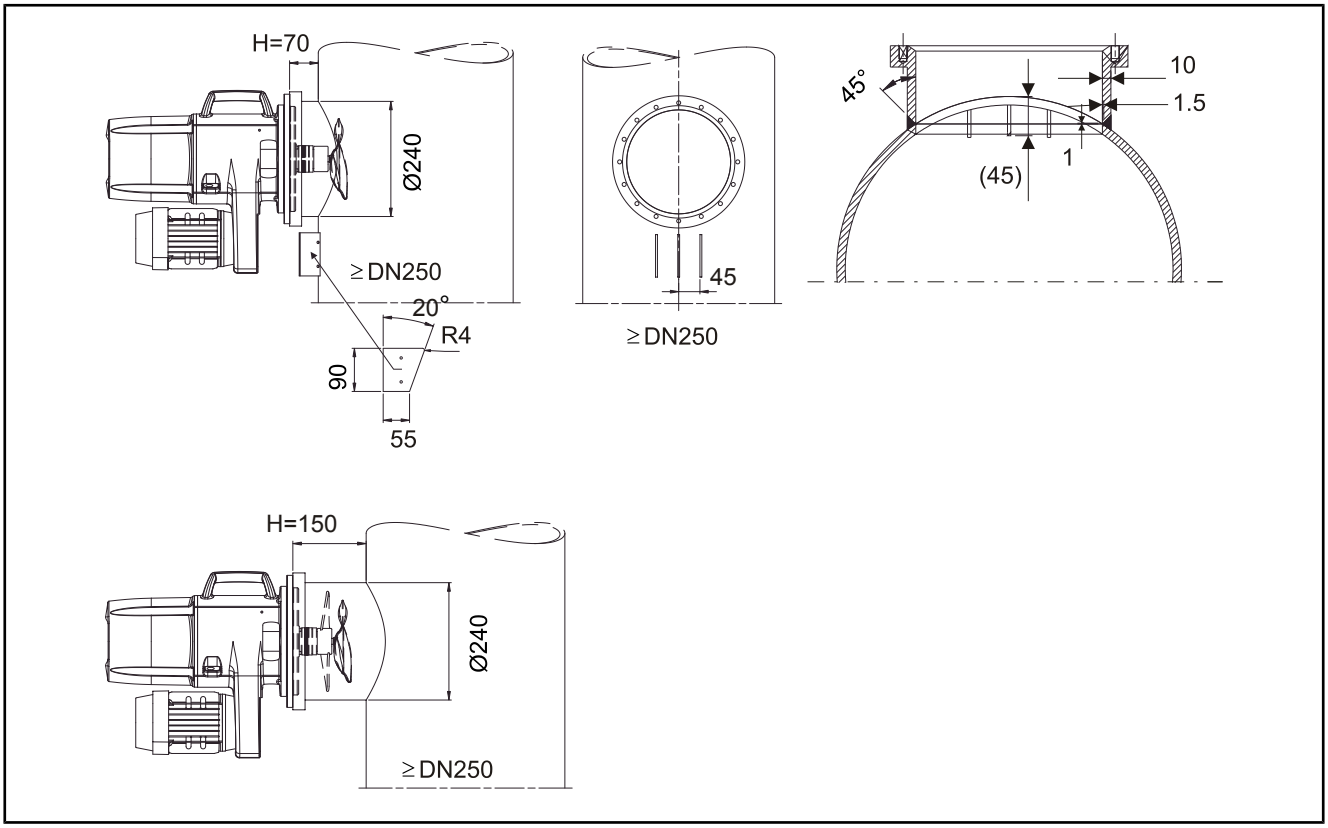


Figure 3.6. Process coupling 70 or 150 mm (2.75" or 6") for ≥ DN250, PN25.

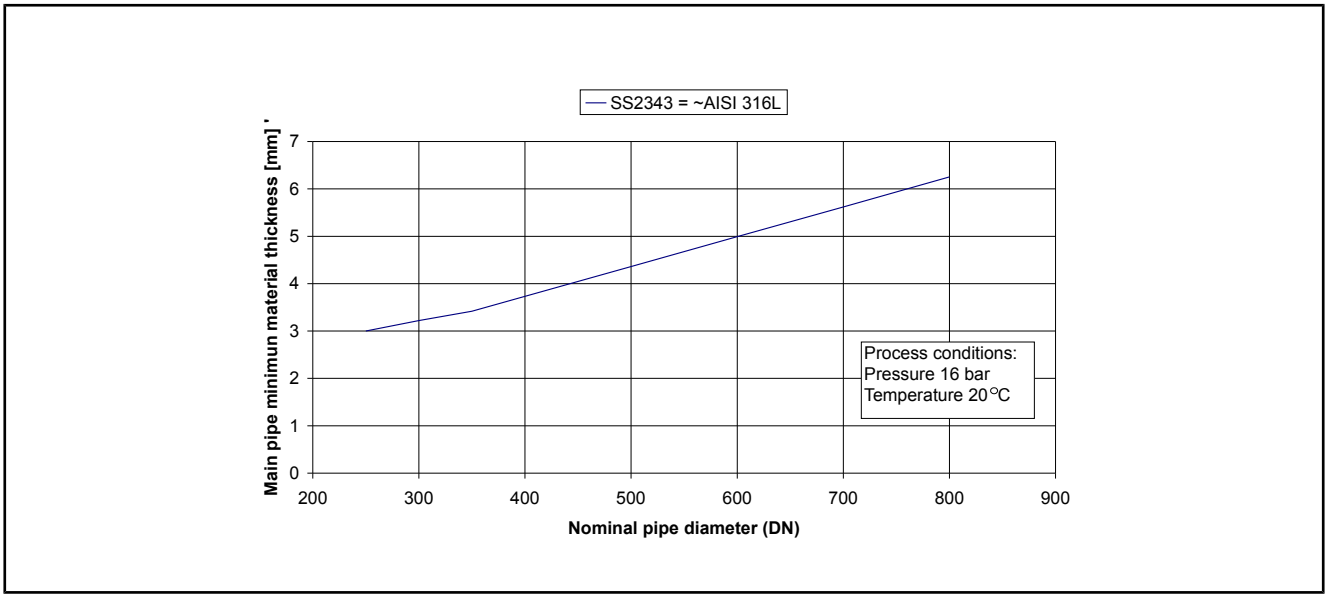


Figure 3.7. Sufficient pipe wall thickness for the required pressure rating (PN16).

Calculation parameters:
Outer diameter 240 mm
Material thickness 10 mm
Temperature = 20 C
Smax = 147 N/mm2

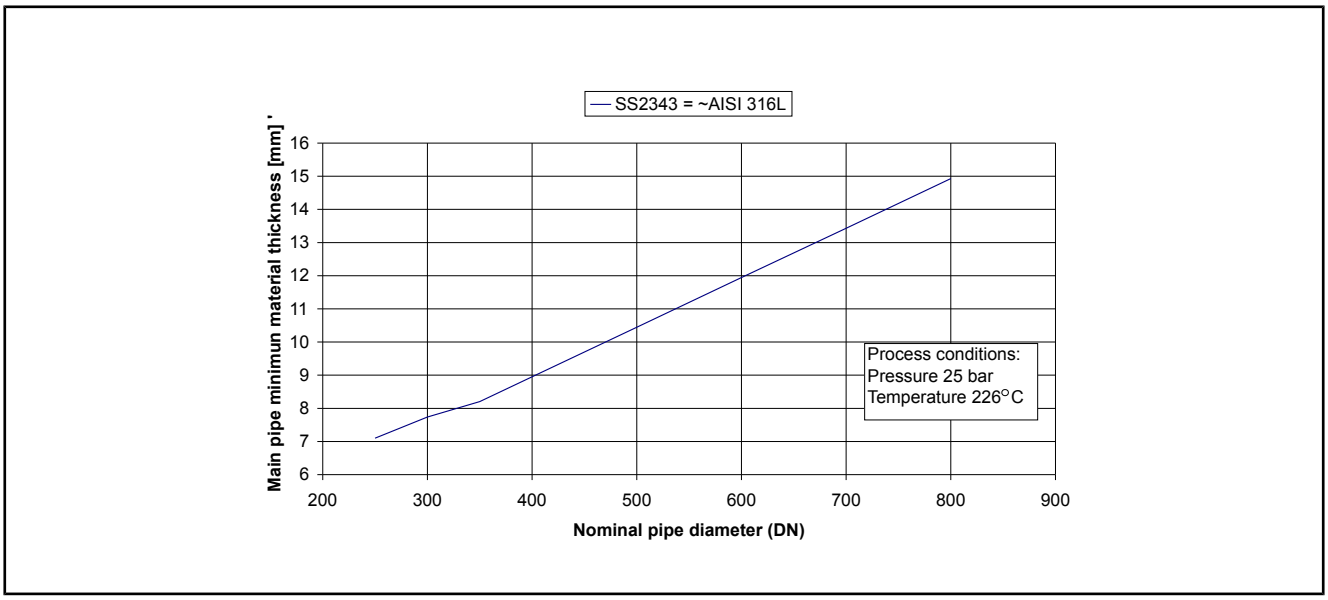


Figure 3.8. Sufficient pipe wall thickness for the required pressure rating (PN25).

Calculation parameters:
Outer diameter 240 mm
Material thickness 10 mm
Temperature = 226 C
Smax = 95 N/mm2

If the process line material thickness is close to the value given in the diagram, use a valid standard for exact calculations. The calculations must include the manufacturing tolerance of the selected pipe.

If the diagram or calculations reveal that the wall of the existing pipe is not thick enough, the pipe must be strengthened. The strengthened pipe section must extend at least 250 mm/10" (PN16), 320 mm/13" (PN25) on both sides of the process coupling.

Typical installations for medium consistency applications are shown in figure 3.9.

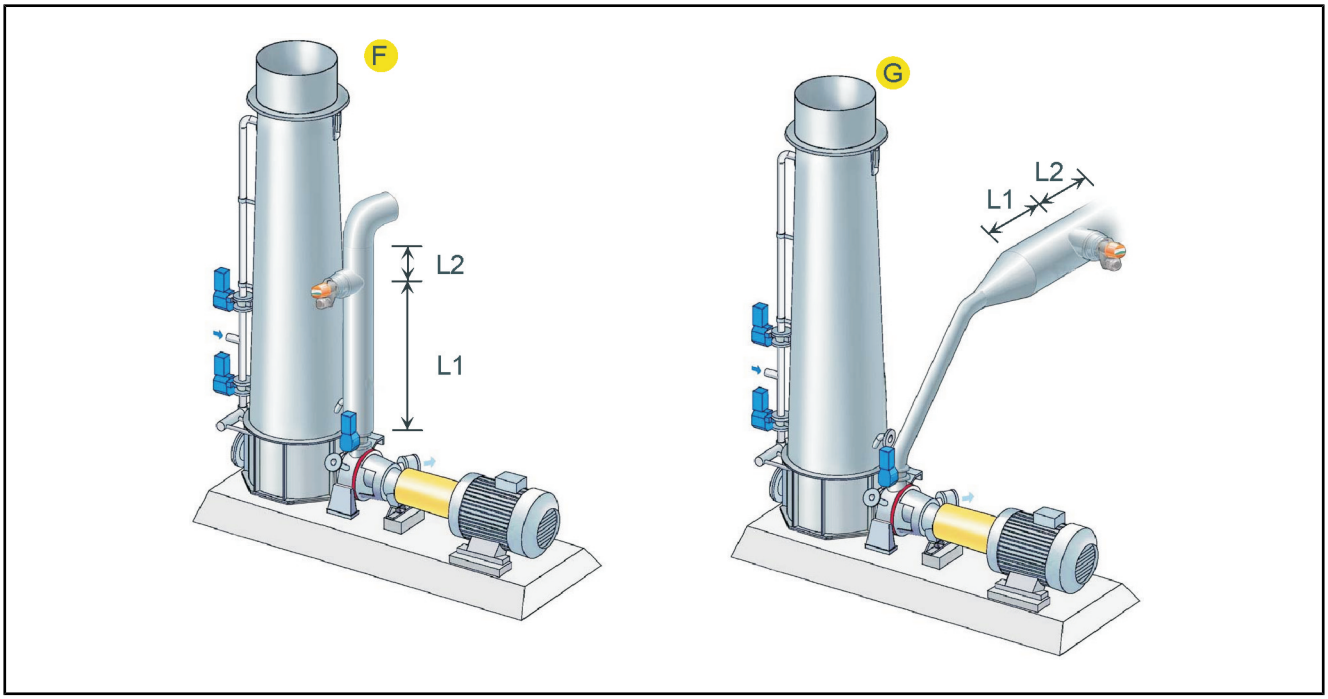


Figure 3.9. Typical installations for medium consistency applications.

3.6. Flushing water connection

All kajaaniROTARY transmitters are equipped with a mechanical seal for the drive shaft. The seal should be flushed with water to produce a cleaning, lubricating and cooling effect. Continuous water flushing is recommended. See figure 3.10.

Use good quality flushing water with no impurities larger than 200 µm. The water is discharged to a drain.

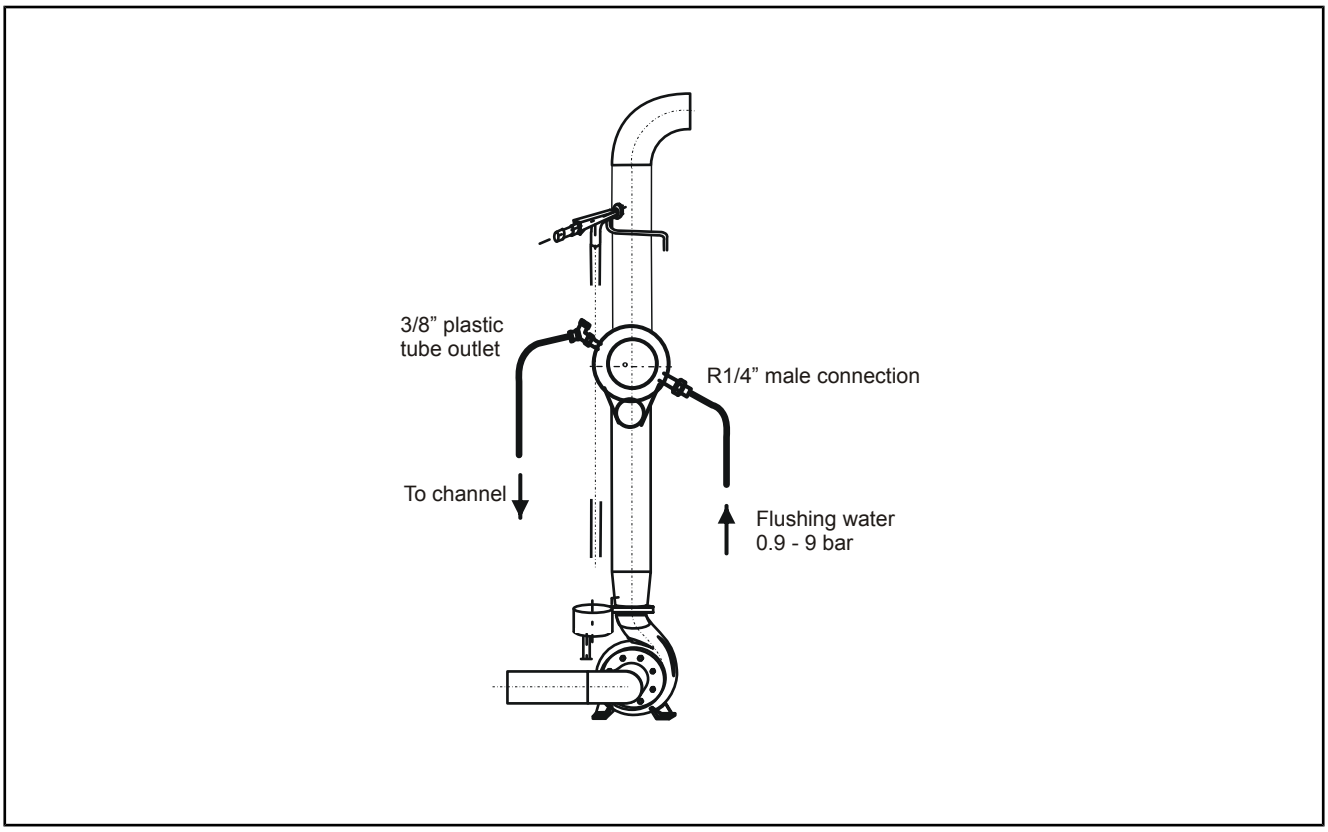


Figure 3.10. Water flushing.

Water flow rate is regulated by a built-in flow controller. External purge meters should not be installed, as they have a definite tendency to clog. The flow rate is from 0.5 l/min (0.13 US gal/min) to 1 l/min (0.25 US gal/min). The pressure can vary from nearly zero to approximately 10 bar (150 psi).

A higher pressure will increase the flow rate, but this is not a critical factor. A flow indicator need not necessarily be installed, but arrangements should be made to observe the water leaving the floor outlet. Connect the incoming water supply directly to the male G 1/4” water inlet connection (1/4 in BSP) at the built-in flow controller. The external diameter of the pipes should be at least 8 mm (0.31"), wall thickness 1 mm (0.04"). Install a shut-off valve close to the transmitter.

Install the water overflow assembly (Y-piece) to the outgoing water pipe. Connect a 3/8" reinforced plastic tube to the outlet, lead it to the floor outlet and fasten just above the floor outlet so that the flow can be observed. The tube should not be bent anywhere so as to restrict the flow-through.

3.7. Connection of electric motor

High voltage motor! Only authorized personnel is permitted to make the connections.

The motor is a standard 3-phase motor.

1. Make sure that the connected motor voltage is correct. If not, adjust the rails in the junction box for the correct voltage, according to the data on the motor type designation plate.

NOTE: Make sure that the connected motor voltage is correct. If not, switch over to the correct voltage.

2. Rotating direction (clockwise) is indicated on the motor housing. When the motor has been connected, start the motor for a moment to check the direction.
3. The use of overload protection is highly recommended to protect the motor.
4. Set the overload protection to the same value as the rated current for the motor (indicated by the rating plate). If the overload protection trips frequently, it may be raised by max. 20 %. However, the external motor temperature must never exceed 80 C (176 F). The temperature can be measured between the two cooling flanges on the outside of the motor.
5. For practical reasons, install the start/stop switches, safety switch, and overload protection close to the motor. This will facilitate calibration and maintenance, when the motor must be started and stopped several times.
6. The motor must be interlocked with the pump motor, so that the transmitter stops when the pump stops.

NOTE: Dry running will rapidly destroy the mechanical seal!

Standard motor connection: See Table 2 in Appendix 1, Technical specifications.

Motor supply cable: Min. 4 x 1.5 mm2 (4 x AWG14). Shield is not required.

When you are satisfied that your kajaaniROTARY has been correctly installed and you are ready to power up the system for calibration, please turn to section 5.1, Quick start check list.

NOTE: Double-check the items in the list before powering up. This list helps to ensure a trouble-free initialization of your system.

4. TCU installation and cabling

4.1. Transmitter Central Unit (TCU) and shield

The TCU is delivered attached to the shield. Attach the shield to the wall with three mounting screws in an easily accessible place. When selecting a place for the TCU, remember that the length of the sensor cable is 10 m. Figure 4.1 shows the mounting dimensions of the shield.

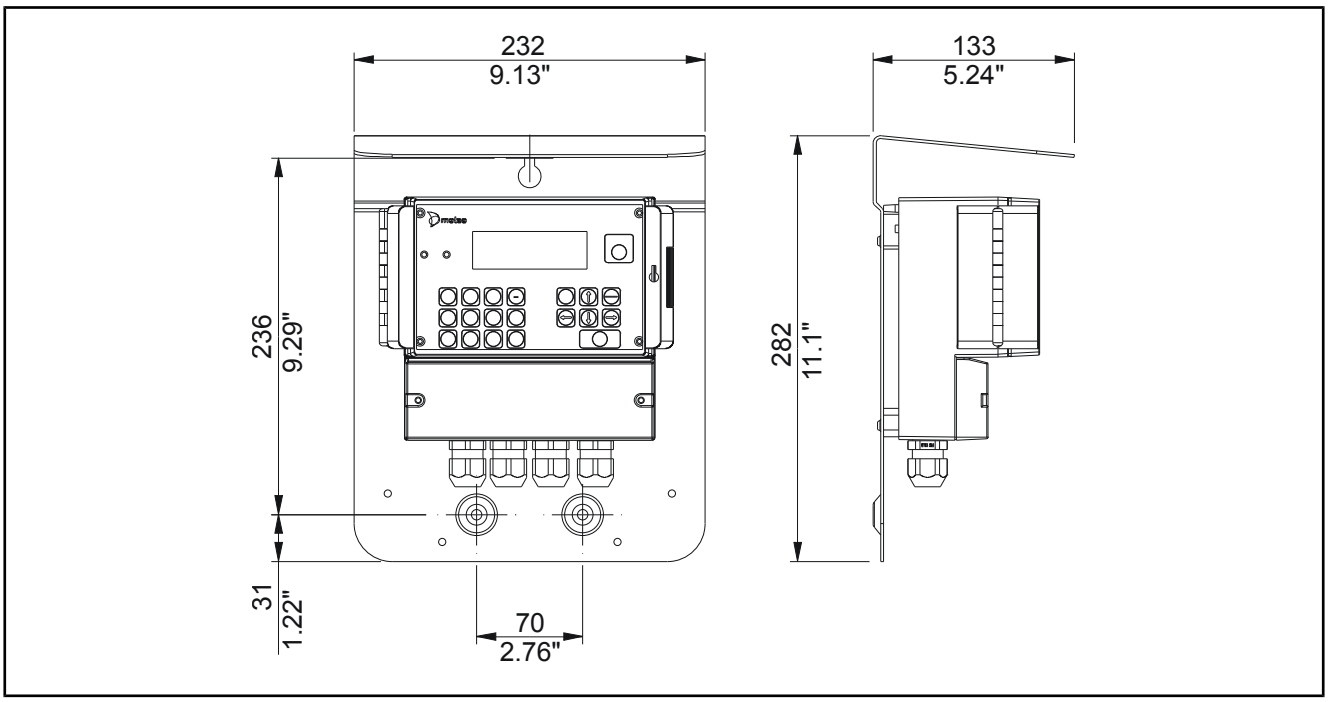


Figure 4.1. Mounting dimensions of TCU shield.

4.2. Electric connections

NOTE: Make sure that the power supply cables are de-energized before connecting them.

NOTE: Make and check all connections before connecting the power supply to the cables.

NOTE: If the TCU has been switched off for a long time, it may take a few minutes before text appears on the display. This delay is caused by the charging of the internal back-up battery and it is perfectly normal.

- In a normal delivery the sensor cable is already connected to the TCU. The connection is shown in figure 4.2.
- Insert the power supply cable 90–260 VAC as shown in figure 4.2.
- Insert the current signal cable into the TCU connector casing through the inlet and connect it to the terminal block as shown in figure 4.2.

– Connect the voltage supply line to connector CS+
– Connect the current output line to connector CS IN
– Do not connect the protective shield of the current signal cable.

NOTE: kajaaniROTARY's current supply is passive and needs an external current source. Figure 4.3 shows the load capacity of the current output as a function of voltage.

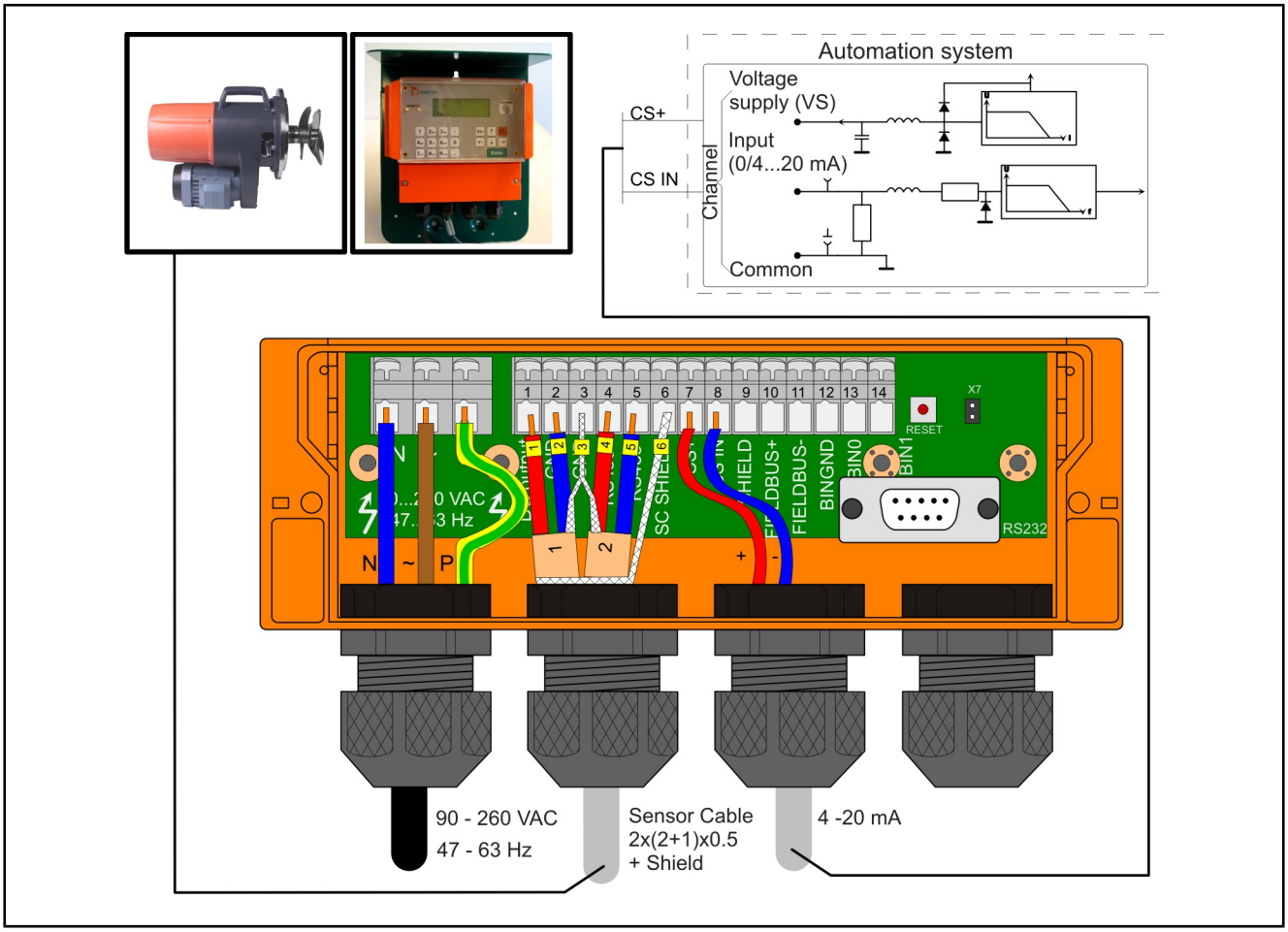


Figure 4.2. Electric connections to the TCU.

Figure 4.3 shows resistance as a function of supply voltage. Resistance here is the sum of load resistor, cable resistance, and power source resistance in the current loop. HART communication requires a minimum loop resistance of 250 Ω .

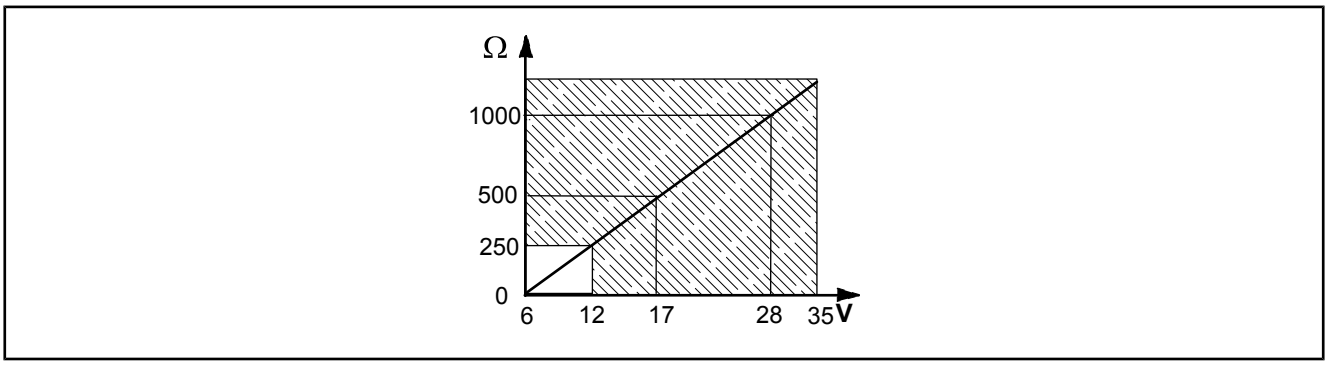


Figure 4.3. Current output load capacity of the TCU.

4.3. Binary inputs

The TCU contains two galvanically isolated binary inputs. BIN0 (connector 13) can be used for recipe selection. BIN1(14) can be used for recipe selection, sampler status or motor running status. The selection is made during configuration; see chapter 6. Both binary inputs share a common ground (12). The switching device must be able to supply 12–28 VDC / 10 mA to the binary input. The connection principle of binary inputs is shown in figure 4.4.

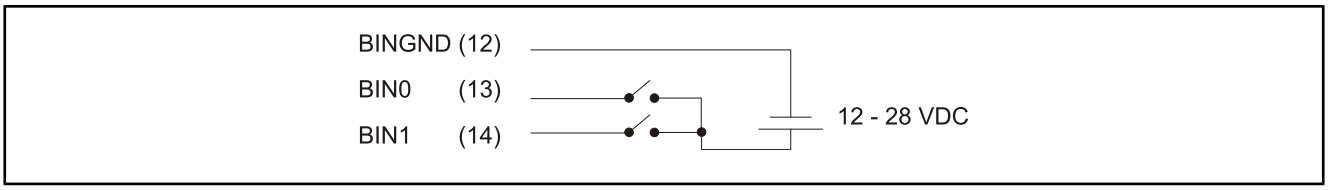


Figure 4.4. Connection principle of binary inputs.

Operation chart

Table 1. BIN1 configured for recipe selection.

BIN0	BIN1	
open	open	recipe 1 selected
closed	open	recipe 2 selected
open	closed	recipe 3 selected
closed	closed	recipe 4 selected

Table 2. BIN1 configured for sampler status.

BIN0	BIN1		
open	open	recipe 1 selected	sampler active
closed	open	recipe 2 selected	sampler active
open	closed	recipe 1 selected	sampler not active
closed	closed	recipe 2 selected	sampler not active

Table 3. BIN1 configured for motor running status.

BIN0	BIN1		
open	open	recipe 1 selected	motor not running
closed	open	recipe 2 selected	motor not running
open	closed	recipe 1 selected	motor running
closed	closed	recipe 2 selected	motor running

5. Setting up

NOTE: If the TCU has been switched off for a long time, it may take a few minutes before text appears on the display. This delay is caused by the charging of the internal back-up battery and it is perfectly normal.

5.1. Quick start checklist

A pressure test with water is recommended to ensure that the mounting chamber / process coupling and transmitter have been correctly installed and do not leak anywhere.

Before switching on the motor, check the following:

1. Make sure that the mechanical seal gets a steady supply of flushing water and also that the water drained out properly.
2. Make sure that the system is turned OFF before attaching the system cable to the transmitter. Tighten the system cable!
3. Check all wirings.
4. Switch on the main power supply and see that the TCU display lights up.
5. Switch on the electric motor briefly and check its rotating direction.

5.2. Important!

NOTE: Do not rotate the sensing element.

The transmitter is a sensitive piece of precision equipment – handle it with care! When installing or removing the transmitter, only lift it by the handle. Be careful not to damage the unit by overload the measuring system.

Before starting the motor, make sure that the mechanical seal gets a steady supply of flushing water (applies to this model). Before starting the transmitter, familiarize yourself with its operation.

- Make sure to check the rotating direction of the motor before admitting pulp to the line.
- Check that the actual “Set point” and “Max feedback” values agree with the corresponding values stated in the attached test protocol.
- Is a suitable Nove sampling valve for pulp located close to the transmitter? This is very important for calibration and check-up of the transmitter.
- When calibrating the transmitter, make sure to take representative samples from the line. The sampling and also laboratory routines should always follow exactly the same procedure.

5.3. Basic configuration and calibration

1. Select the language and temperature unit (Celsius/Fahrenheit); see chapter 6.5.3.
2. Set the device date and time; see chapter 6.5.5.
3. Scale the current output; see chapter 6.5.2.
4. Calibrate the consistency; see chapter 6.6.

6. Operation and user interface

6.1. General

kajaaniROTARY can be operated either by using the local user interface TCU or remotely by digital communication over the 4–20 mA output loop (HART communication protocol).

Total support, including sophisticated calibration methods and thorough diagnostics, is available from Metso Field Care. Please refer to the DTM user manual. Basic functionality is available for other field communicators or control systems capable of HART communication; the operation menu for 275 HART Communicator is in Appendix 4.

The local operation unit of kajaaniROTARY is the Transmitter Central Unit (TCU); see figure 6.1.

Figure 6.1. Transmitter Central Unit, TCU.

6.2. TCU user interface

TCU has a 20-column, 4-line LCD display, and a 20-key keypad for entering information. The keypad controls are as follows:

Number keys:
Use the number keys to enter numerical data and to choose menus. On certain displays you can also enter letters. To enter letters, press a number key several times and the letters appear on the display one after another.

Sample:
Use the Sample key to start and stop a sample.

Edit/Save
Use the Edit/Save key to go into Edit mode. When you are in Edit mode, use this key to save data.

ESC
Use the ESC key to exit from Edit mode without saving data. You can also use the key to toggle between the main display and the function menu.

Enter
Use the Enter key to move between the main display and the Info display. In Edit mode, use the Enter key to jump to the next edit field.

Back arrow
Use the back arrow in Edit mode to return to the previous character.

Forward arrow
Use the forward arrow in Edit mode to move to the next character.

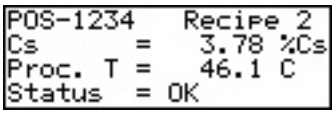
Down arrow
Use the down arrow to scroll down if the display contains more than four lines. A downward-pointing arrow in the bottom right corner of the display indicates that you can scroll down. You can also use the down arrow to scroll between edit field options.

Up arrow
Use the up arrow to scroll up if the display contains more than four lines. An upward-pointing arrow in the top right corner of the display indicates that you can scroll up. You can also use the up arrow to scroll between edit field options.

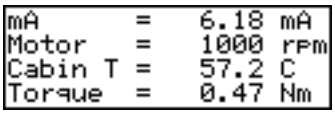
6.3. Operation with the TCU

Introduction to the TCU user interface

You can always return to the Measurement Display by pressing ESC several times. The Measurement Display is the default after power-up.

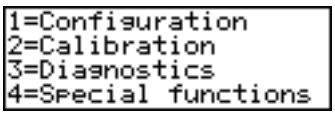


The measurement display shown above is the default one, and when you press ENTER the second measurement display will appear, showing the following information.



Pressing again ENTER to return to the first Measurement Display.

Press ESC in either of the measurement displays to access the operations menu (TCU's main menu). The operations menu looks like this.



The operations menu has four menu items and fits entirely on the four-line display of the TCU. Some other menus have more than four items, and in these cases an arrow in the top/bottom right corner of the display indicates that the entire menu cannot be shown at once. You can then use the UP ARROW and DOWN ARROW keys to scroll the display.

To access a menu function or submenu, press the number key indicated before the name of the function/submenu. Press ESC to return to the previous level.

All TCU functions can be accessed from the operations menu. Figure 6.2 shows a map of the TCU functions and their locations in TCU display system.

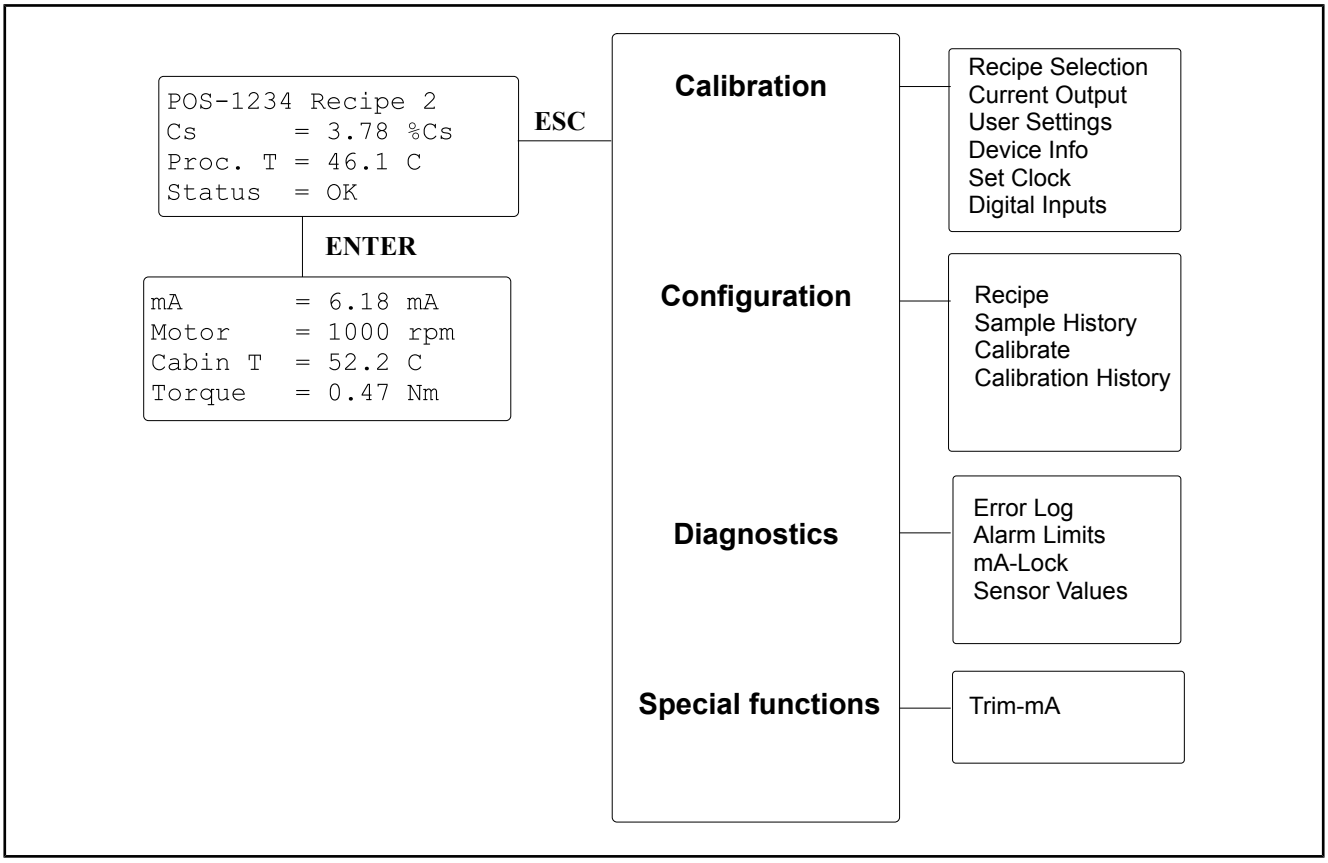
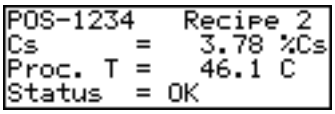


Figure 6.2. TCU menu system.

6.4. Measurement displays

The first measurement display shows the most important information at a glance.

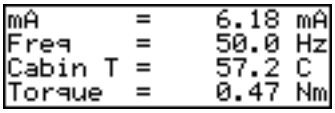


The top left corner shows a tag (= transmitter's position code in the system); in this example it is "POS-1234". This value can be changed in the User Setting display (see below).

The top right corner shows the number of the currently selected recipe; in this example "Recipe 2". This value can be changed in the Recipe Selection display (see below). Letter "R" after the number indicates that remote recipe selection is in use. In this case the active recipe is selected by two digital input signals on the TCU unit.

The next two lines contain data measured by the consistency transmitter: consistency and process temperature (pulp temperature). Consistency is given in percentage points (% Cs), pulp temperature in degrees Celsius (C = C) or Fahrenheit (F = F). The temperature unit can be changed in the User Setting display (see below). The last line shows device status information (OK / error or warning).

The second measurement display contains additional information.



The first line indicates the state of the transmitter's analog output in milliamps (mA). The second line gives the rotation frequency of the electric motor. The third line shows cabin temperature ("housing temperature"), in degrees Celsius (C = C) or Fahrenheit (F = F). The temperature unit can be changed in User Setting display (see below). The last line shows the torque (shear force) detected by the device, in Newton meters (Nm).

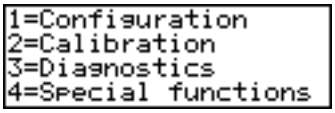
6.5. Configurations

Here you can define and program the application's basic parameters. Configuration is usually done only once, before installing the transmitter. When defining the upper and lower range limits, take into account the measurable minimum consistencies and recommended maximum consistencies specified for each sensor/pulp type (see table 1 in Appendix 1, Technical specifications).

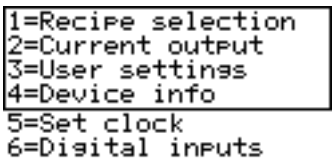
However, in configuration it is possible for example to set 0 % Cs as the lower range value regardless of warnings, provided that the consistency will not actually drop below the specified measurable minimum. In the same way it is possible to exceed the specified upper range-value in configuration.

However, the measurement may be affected by flow velocity if the actual consistency in the process goes above the recommended maximum limit. Also take into account that the transmitter's minimum span is 0.8 % Cs and its maximum span corresponds to 1.5 Nm shear force, depending on the selected sensor/pulp type.

To access the configuration functions, press key 1 in the operations menu (TCU's main menu).



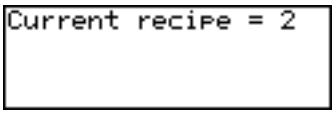
The following menu will appear.



Each of these functions is described in the following subsections.

6.5.1. Recipe selection

Recipe selection function indicates which recipe is currently used.

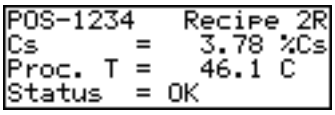


If you want to change the active recipe number, press EDIT/SAVE once. The cursor starts to blink at the recipe number to indicate that you can edit the number.

An informative text appears on the lower part of the display. Pressing keys 1 to 4 will select a fixed recipe, and pressing any other number key will activate remote selection. Remote selection is indicated by letter "R" instead of recipe number. When remote selection is activated, it overrides fixed recipe selections by the operator, and the active recipe is selected instead by the TCU's digital inputs.

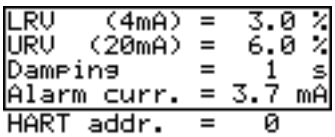
Press the number of the desired recipe on the TCU keyboard, and then press EDIT/SAVE to accept and save your selection. If you do not want to make any changes, press ESC to return to the previous menu level (Configuration menu).

Remotely selected recipe is indicated in the measurement display with letter "R" after the recipe number; example:



6.5.2. Current output

Configuration / Current ouput view:



LRV = Lower range value: Lower range value, % Cs.
This is the consistency percentage that produces the 4 mA analog output signal. A warning is displayed if the value is lower than the sensor's lowest measurable consistency. Default: 3.0 % Cs.

URV = Upper range value: Upper range value, % Cs.
This is the consistency percentage that produces the 20 mA analog output signal. A warning is displayed if the value is higher than the sensor's recommended upper limit. If the span is too wide (> 1.5 Nm), kajaaniROTARY will not accept the upper limit, and you will have to either lower the upper limit and/or raise the lower limit. The span may also be too narrow (< 0.8 % Cs), in which case you have to raise the upper limit and/or decrease the lower limit. Default: 6.0 % Cs.

Damping
Damping the fluctuation of the output signal, 1 to 60 seconds. Define at least the minimum value required to damp harmful fluctuations.

Alarm current
Analog output current to indicate transmitter failure. Possible values are 3.75 mA, 22.5 mA, HOLD (analog output is frozen when alarm goes on) and NONE (no alarm signal at all). Default: 3.75 mA.

HART-address
HART® address of the device. Acceptable values are from 0 to 15. Default: 0, i.e. normal installation with a single transmitter, analog output signal (4–20 mA) is active. Values 1–15 define a fixed 4mA current output and all communication with the device is performed through the digital HART protocol.

Warning: Do not set values 1–15 if the 4–20 mA analog output signal is needed!

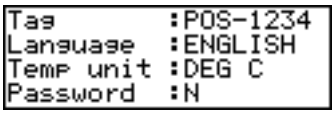
To modify these configuration values press EDIT/SAVE once. The cursor starts to blink at the LoCs value to indicate that you can edit the number. Enter the new value with the number keys and press ENTER, or just press ENTER to accept the existing value. Follow the same procedure when entering the values for HiCs and Damping.

To set the Alarm Current press the UP and DOWN arrow keys to switch between the available alternatives. Enter the HART address with the number keys. Press EDIT/SAVE to save and activate your selections.

If you do not want to make any changes press ESC to return to the previous menu level (Configuration menu).

6.5.3. User settings

Press ESC in the main display to open the Operations menu, and then select Configuration/User settings. The following menu will appear:



Tag
Transmitter's tag is a text describing the installation position of the device. Max. 8 characters, either letters or numbers.

Language
Display language selection. Available options: Finnish, English, Swedish, French, German.

Temp unit
Temperature unit, C = C / F = F. Default value is C.

Password
The access to some operations is restricted by a password. Accepted values: Yes/No. When Yes is selected, a password will be required before entering Edit mode and before taking a calibration sample. The password is 3121. As default, the password is not in use.

To modify these configuration values press EDIT/SAVE once.

The cursor starts to blink in the Tag field to indicate that you can edit the value. To accept the existing value press ENTER. If the tag must be modified, follow the procedure below:

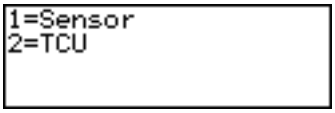
- Starting with the first character, press the key that contains the desired character (number or letter) several times until the desired character appears on the display.
- Press RIGHT ARROW to advance to the next character.
- Repeat these steps for the next characters.
- You can go back to modify the preceding characters by pressing LEFT ARROW.
- When all the characters are selected, press ENTER to accept the selection.

All the other settings follow the same logic: use the UP ARROW and DOWN ARROW keys to change the value and press ENTER to accept the selection, or just press ENTER to accept the existing value. Finally press EDIT/SAVE to save and activate your selections.

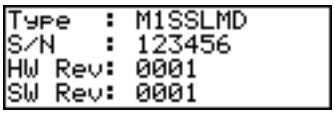
If you do not want to make any changes, press ESC to return to the previous menu level (Configuration menu).

6.5.4. Device info

In the Configuration menu, press key 3 to select Device Info. The following menu will appear:



Press key 1 to view Sensor information. This data is shown for information only and cannot be changed.



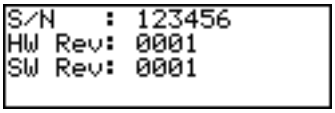
Type
Type describes the sensing element, material, etc. See Technical specification for more details. Default: the supplied sensor.

S/N
Serial number of sensor electronics.

HW Rev
Version number of sensor electronics.

SW Rev
Software version of sensor electronics.

In the Device Info menu, press key 2 to view the corresponding data for the TCU. This data is shown for information only and cannot be changed.



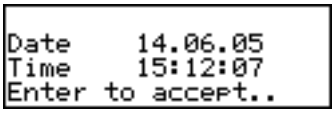
S/N
Serial number of sensor electronics.

HW Rev
Version number of sensor electronics.

SW Rev
Software version of sensor electronics.

6.5.5. Set clock

The Set clock display shows the following view:



The display shows the current date and time. This date and time are used as a time stamp in the trend table and for calibration samples. The main display status line reads "Set clock" until the time has been set. If the date and time are correct, press ENTER or ESC to exit this display.

To change the date and time, press EDIT/SAVE. The first character in the field begins to blink. Enter the date with the number keys: first the day, then month, then year. Example: to enter the date 14.06.2005 (June 14, 2005) the key sequence is as follows:

1 4 ENTER 0 6 ENTER 0 5 ENTER

Enter the time in the same way. Then press EDIT/SAVE to save and activate your selections.

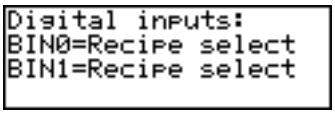
If you do not want to make any changes, press ESC to return to the previous menu level (Configuration menu).

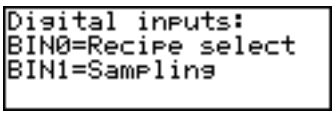
6.5.6. Digital inputs

There are two digital input signals available in the TCU unit (BIN0 and BIN1). BIN0 is always used for recipe selection (in remote recipe selection mode), while the use of BIN1 is selectable. There are two alternatives:

- If BIN1 is used for recipe selection, all four recipes can be activated through input signals.
- If BIN1 is used for sampling information, sample timing can be automated (no need to press the SAMPLE key) but only two recipes (recipe 1 and recipe 2) can be activated through input signals.

In the Digital inputs display, one of the following views will appear:





To modify the configuration press EDIT/SAVE.

The cursor begins to blink at the BIN1 value to indicate that you can edit it. Use the UP ARROW and DOWN ARROW keys to change it and then press ENTER to accept the selection, or press ENTER to accept the existing value.

If you do not want to make any changes, press ESC to return to the previous menu level (Configuration menu).

6.6. Calibration

6.6.1. General information

Figure 6.3 shows the calibration principle. As the graph shows, the relationship between consistency and the torque detected by the sensor is not linear and it differs for different pulp types, sensing elements etc.

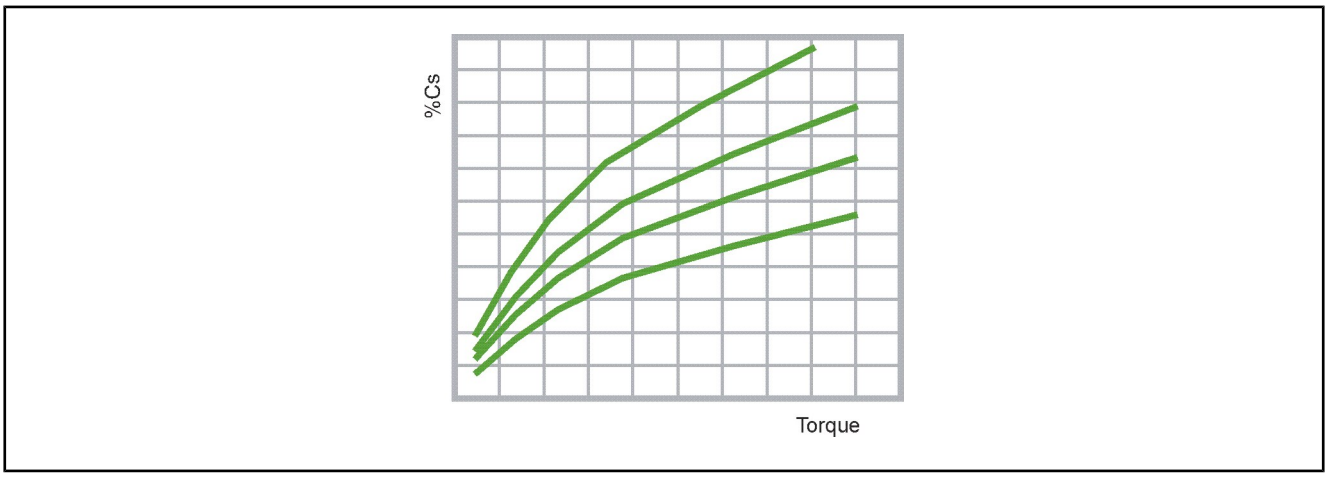


Figure 6.3. Calibration principle.

The calibration curves, determined experimentally in Metso Automation's laboratory, represent consistency (% Cs) as a function of the torque (Nm) acting on the sensor. kajaaniROTARY produces accurate consistency readings by compensating the detected torque with the information from a calibration curve.

The kajaaniROTARY is delivered with factory calibration and it thus able to measure consistency as soon as the power is switched on. Factory calibration is performed on the device during final factory testing using pure water.

We recommend calibrating the device again when setting it up, in order to optimize the device settings for the conditions in which it will be used. Perform calibration by taking a consistency sample and entering its laboratory value into kajaaniROTARY, as instructed below. When this has been done, the status line on the display will change from Factory Calibration to OK.

The transmitter should be calibrated for each pulp type used. You can save calibrations for 4 pulps or pulp mixes in the transmitter's memory. In the transmitter's post-installation calibration, consistency samples are used to tune the selected calibration curve for the pulp to be measured. Tuning is done either as single-point calibration to define the zero offset P2, or as two-point calibration where you also define the curve's slope correction P1 (see figure 6.4.). For more detailed descriptions of these two calibration methods, see below in this section.

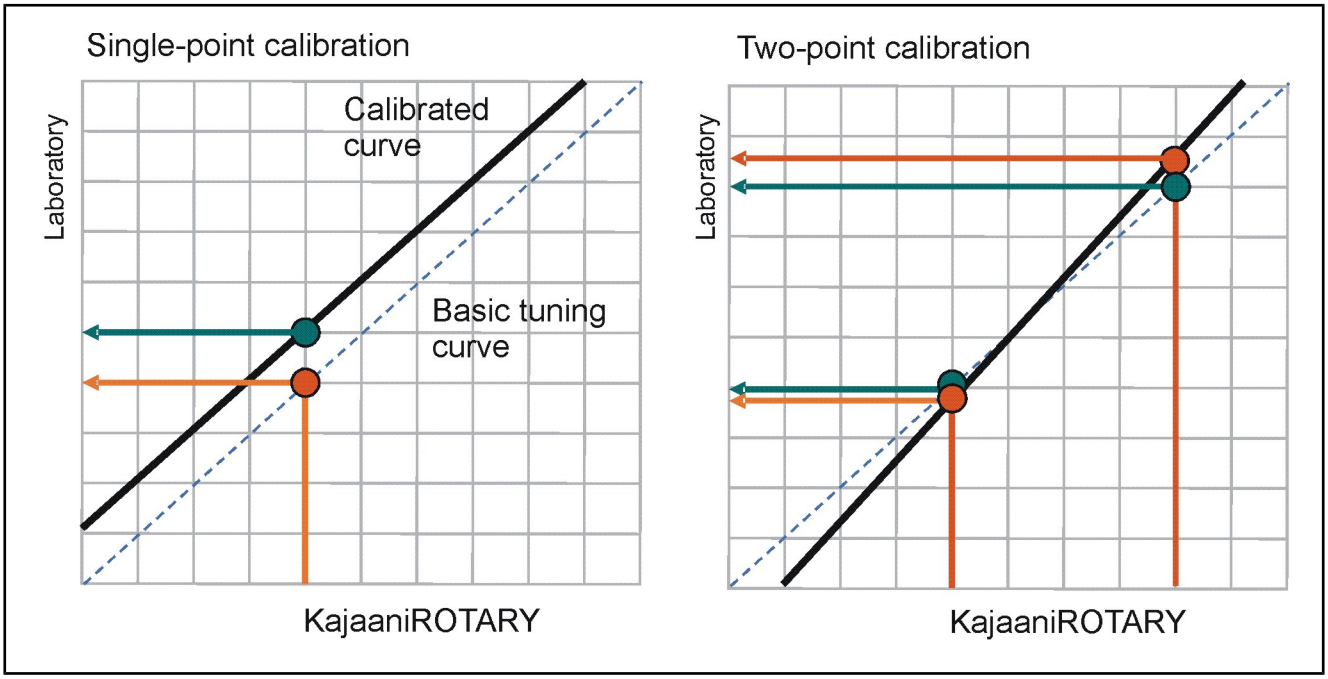


Figure 6.4. Single-point and two-point calibration.

In the original curve, P1 = 1 and P2 = 0. In sample-based calibration the kajaaniROTARY will itself calculate the corrections for P1 and P2 in accordance with laboratory results and samples. Calibration results: P1 and P2 parameters are stored in recipes. A recipe is a set of information that the device needs in order to convert the measured torque value to consistency. When the consistency transmitter knows the pulp recipe, it can accurately convert torque to % Cs.

You can save 1–4 recipes for different pulp types in the transmitter's memory. The desired calibration can be activated either directly from the transmitter or with remote selection through binary inputs or HART®. Calibrations and other operations are carried out through menus, no mechanical settings or changes are needed. Calibration data is preserved in memory even if power is switched off.

Single-point calibration

In this calibration the selected curve, which converts the torque into a consistency signal, is moved in the required direction according to consistency. The goal is to achieve zero offset at the calibration point, thus eliminating the difference between the measured consistency and sample consistency. The slope of the curve (slope factor P1) does not change, but the value of P2 changes in accordance with the zero offset.

In single-point calibration you can also take two samples and use the one taken when the process was steadier. The samples should preferably be taken at the so-called setpoint consistency.

In most cases single-point calibration is sufficient for consistency control applications.

The calculation formula:
P2 = LAB – sample average
P1 = unchanged

Two-point calibration

In this calibration the selected curve, which converts the torque into a consistency signal, is moved in the required direction according to consistency. The goal is to achieve a zero offset at the calibration point and to change the slope of the curve as necessary, so that the curve passes through two consistency points. kajaaniROTARY calculates new values for P1 and P2.

IMPORTANT: In two-point calibration the difference between the consistency points must be at least 25 %, calculated from the lower point. This ensures that possible errors in sampling and consistency analysis will not have a noticeable effect on the slope of the curve. kajaaniROTARY will alert the operator when an attempt is made to calibrate using points whose consistency difference is less than 25 %.

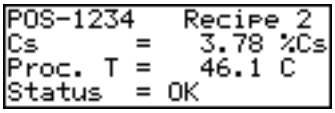
Two-point calibration is recommended in cases when accurate measurement is needed over a wide measuring range, when calibrating a pulp mix or pulp type that does not have a predefined calibration curve in the menu, or when the pulp has a large, unknown filler content. Considerable differences may also occur between different recycled fiber pulps in relation to the basic slope of the calibration curve.

The calculation formula:
P1 = (2 Cs LAB – 1 Cs LAB) / (2 Cs SAMPLE – 1 Cs SAMPLE) P2 = 1 Cs LAB – (P1 x 1 Cs SAMPLE)

6.6.2. Sample taking

kajaaniROTARY assists in sample taking by calculating the average consistency value and standard deviation for the sampling period. kajaaniROTARY is able to calculate and remember 16 samples for each recipe.

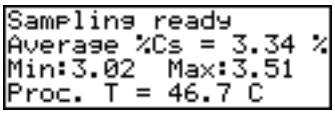
To take a sample, go to the first measurement display:



Then press the SAMPLE key (on the right side of the display). The display shows the current consistency and some instructions.

The device is now waiting for the start of sampling. Press SAMPLE again right before taking a pulp sample. The device begins to average the measurement result and the message "SAMPLING" appears on the Status line.

During the sampling period, the sample is taken from the process pipe with a NOVE sampling valve. When sample taking is completed, press SAMPLE once more to stop the sampling sequence. The sampling result will then appear on the display, and the collected information is saved in the device's memory.



In addition to the average consistency, the device also shows the minimum and maximum values and process temperature during the sampling period. The minimum and maximum values indicate consistency fluctuation during the sampling period.

This fluctuation should be small to ensure that the consistency sample is reliable. If the difference between minimum and maximum consistency is very large, the pulp has varied a lto and this sample should not be used for calibration. Please take another calibration sample.

Press ESC or ENTER to move back in the menu structure.

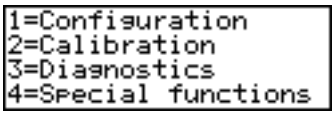
The sample is stored in the sample history of the recipe that was active during the sampling period. Up to 16 samples can be saved for each recipe. If more than 16 samples are taken for onerecipe, the oldest samples will be written over.

When using a NOVE sampler equipped with a switch that applies a 24V voltage to binary input 2 when NOVE is closed, the device will not collect sampling data. When NOVE is open (= in the sampling position), the measurements are included in the sampling data.

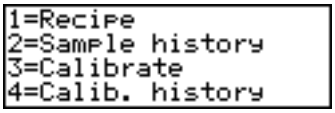
The obtained sample will then be analyzed in the laboratory to determine the total consistency and filler percentage of the sample. These will be entered to TCU in the sample history display; instructions below.

6.6.3. Calibration menu

To access the calibration functions press key 2 in the operations menu (TCU's main menu).



The following menu will appear:

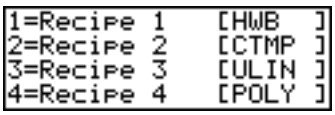


Each of these functions is described below.

6.6.4. Recipe

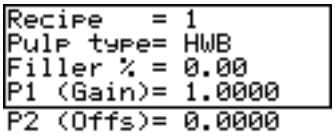
A recipe is a set of information that the device needs to convert the measured torque value into consistency. The recipe function can be used to view and tune recipe parameters.

First select the recipe you wish to edit. kajaaniROTARY's memory contains four recipes, identified by a number and the pulp type used for it.



Press the number of the recipe (1…4) you wish to view.

The display contents may differ depending on pulp type. Special fields are available for some special purpose pulp types; for further information see below. For the predefined pulp types (HWU, HWB, SWU, SWB, GW, TMPL, TMPH, RMPL, RMPH, CTMP, RCFS, ROCCS, EUCAU and EUCAB) the display contains only the basic tuning parameters.



Pulp type

There are several predefined calibration curves available for the most common pulp types. These curves have been determined experimentally in Metso Automation’s laboratory. The available pulp types are:

HWU
Unbleached hardwood chemical pulp, e.g. birch pulp or eucalyptus, bagasse and other agro fibers.

HWB
Bleached hardwood chemical pulp, e.g. birch pulp or eucalyptus, bagasse and other agro fibers.

SWU
Unbleached softwood chemical pulp, e.g. pine and other softwood pulps.

SWB
Bleached softwood chemical pulp, e.g. pine and other softwood pulps.

GW
Groundwood, including pressure groundwood.

TMPL
Thermomechanical pulp, low freeness.

TMPH
Thermomechanical pulp, high freeness.

RMPL
Refiner Mechanical Pulp, low freeness.

RMPH
Refiner Mechanical Pulp, high freeness.

CTMP
Chemi-thermomechanical pulp.

RCFS
Recycled fiber, screened.

ROCCS
Recycled fiber, OCC, screened.

EUCAU
Unbleached eucalyptus.

EUCAB
Bleached eucalyptus.

There are three more pulp types for special purposes:

ULIN
Unlinearized 0–1.5 Nm torque range, the corresponding output display is 0–100%.

POLY
Third order polynome conversion from torque to consistency.

SPG
Special Grade. Torque-to-consistency relationship is determined by a curve defined by max. 16 points. Between two consecutive points the values are interpolated linearly.

Filler %
Filler % (ash %) of the pulp, i.e. the percentage of fillers from total solids.

P1
Curve slope correction factor. In normal calibration use the default P1 = 1 (see figure 6.3.).

P2
Offset term (zero correction). In normal calibration use the default P2 = 0 (see figure 6.3).

NOTE: As kajaaniROTARY only measures fiber consistency, variations in filler content after calibration will cause a corresponding error in the total consistency measurement with respect to filler.

As stated above, the recipe display can be used to view the recipe parameters. After calibration, check and write down the recipe parameters of configured transmitters, including the P1 and P2 values calculated by kajaaniROTARY, and archive them. They may be needed later on, for example if the TCU has to be replaced: after replacement, no calibration is needed as the same recipe parameter values can be entered to the new unit in the recipe display.

The recipe display can also be used to tune the recipe parameters. For example, if you increase the value of P2 by 0.1, the consistency reading will also increase by 0.1% Cs. Thus you can make the required zero correction without other calibration measures.

To modify the recipe parameters press EDIT/SAVE.

The cursor starts to blink in the Pulp type field to indicate that you can edit it. Use the UP ARROW and DOWN ARROW keys to select the desired pulp type and then press ENTER to accept the selection, or just press ENTER to accept the existing value.

The output for uncalibrated measurement (pulp type ULIN) is shown as a percentage of the maximum span (1.5 Nm). The consistency percentage display can be activated after configuration and recipe selection. When delivered, the transmitter is provided with the typical default configuration and recipe, i.e. pulp type selection.

Enter filler % with the number keys. Example: for 12% the key sequence is as follows:

1 2 ENTER

Enter parameters P1 and P2 in the same way and then press EDIT/SAVE to save and activate your selections.

If you do not want to make any changes, press ESC to return to the previous menu level (to recipe selection).

The information above deals with the predefined pulp types. The special purpose pulp types are described below.

ULIN – Unlinearized measurement

The output for uncalibrated measurement is shown as a percentage of the maximum span (1.5 Nm), i.e. 0 Nm corresponds to 0% and 1.5 Nm corresponds to 100%. Otherwise ULIN is similar to the predefined pulp types.

POLY – Polynome

If no suitable predefined calibration curve is available, a special curve can be created by using the POLY pulp type in a recipe. POLY is a third-order polynome conversion from torque to consistency.

When POLY is selected for pulp type, the recipe display contains the following information:

```
Recipe   = 1
Pulp type= POLY
Filler % = 0.00
P1 (Gain)= 1.0000
P2 (Offs)= 0.0000
Factor x3= 0.1
Factor x2= 0.2
Factor x1= 1.0
Factor x0= -0.1
```

In comparison to predefined pulp types, this recipe contains four additional fields: factors x3 to x0 for third-order polynomial conversion.

To generate the factors for polynomial conversion, several torque and consistency values are needed. These can be obtained for example by taking samples that cover the entire operating range. These torque-consistency pairs are then entered into a mathematics software which fits a third-order polynome into the measured data. A number of different general-purpose mathematics software are able to handle this. Finally enter the factors of the polynome to the TCU in the recipe handling display.

NOTE: If the data points do not cover the entire operating range, there may be unexpected behavior when the torque goes out of the sampled area.

SPG – Special Grade

In some special cases the available pulp type curves may be unsatisfactory even after two-point calibration. In such cases the Special Grade function can be used to correct the curve through a max. 16-point offset table.

In the table you can enter 16 data points, giving the known consistency values relative to the torque values measured by kajaaniROTARY, and thus define a curve of desired shape. For consistencies below the table's minimum non-zero consistency level, the offset of the minimum is applied. For consistencies above the maximum consistency level, the offset of the maximum is applied.

Consistencies between the table values are calculated by linear interpolation using the offsets of the next lower and higher consistencies. Figure 6.5 shows an example of a special grade calibration curve.

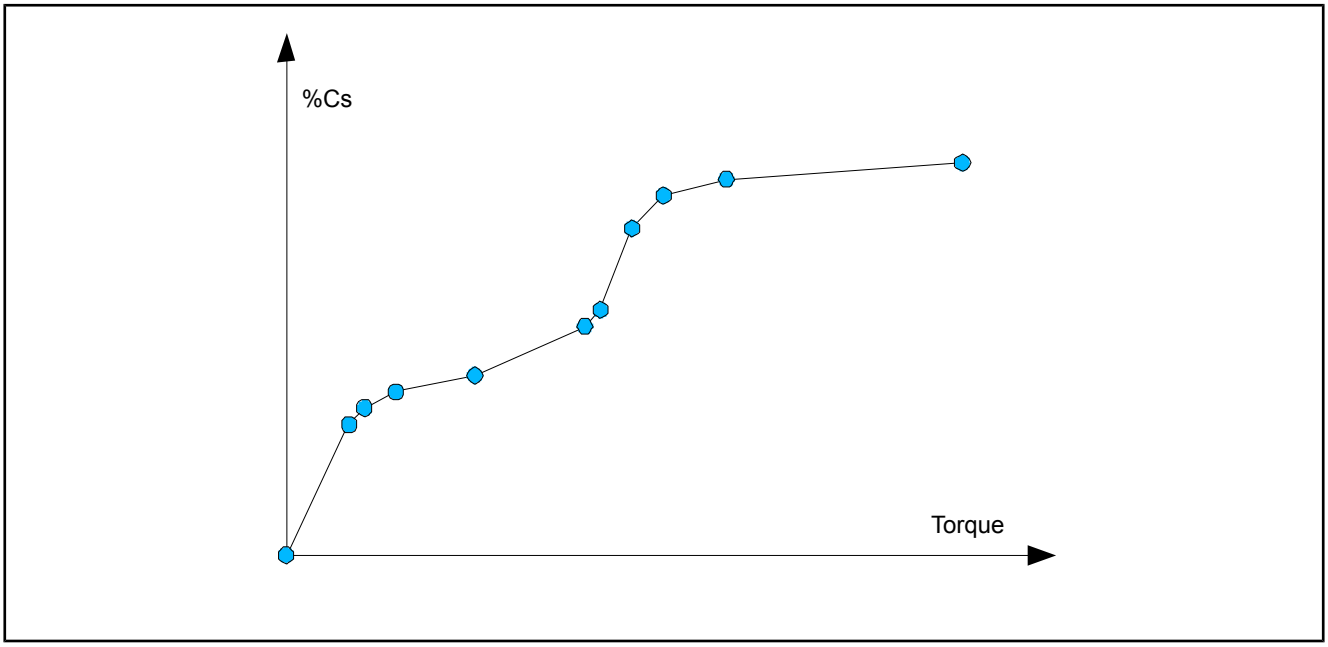


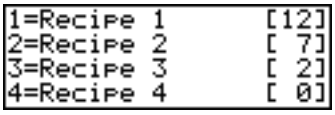
Figure 6.5 Special Grade curve.

The Special Grade curve is activated when pulp type SPG (SPecial Grade) is selected. In this case the torque-consistency values are included at the end of the basic recipe parameters.

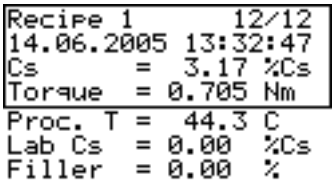
```
Recipe    = 1
Pulp type= SPG
Filler % = 0.00
P1 (Gain)= 1.0000
P2 (Offs)= 0.0000
     Torque   %Cs
1.   0.00     1.57
2.   0.20     2.87
3.   0.30     3.57
4.   0.40     4.19
5.   0.50     4.54
6.   0.60     4.70
7.   0.70     4.91
8.   0.80     5.07
9.   0.90     5.19
10.  1.00     5.46
11.  1.10     5.62
12.  1.20     5.75
14.  1.30     5.79
15.  1.40     5.86
16.  1.50     5.91
```

6.6.5. Sample history

When a sample is taken, kajaaniROTARY saves its consistency values in memory. This information can be viewed in the sample history display. The device contains four recipes, each with a separate sample history. First select the recipe before viewing sample history data.



The recipe selection display for sample history is shown above. The recipe number is followed by a number inside brackets, indicating how many samples are available for this recipe. When the recipe is selected, the display will show information on the latest sample taken for this recipe.



Only the basic information is first shown on the display. Additional information can be viewed by scrolling the display with the UP and DOWN keys.

The first line shows the recipe number, index of the current sample, and the number of samples available for the recipe. The second line shows the sampling date and time. The next three lines contain sampling data measured by kajaaniROTARY: consistency, torque and, process temperature. The last two lines show the laboratory consistency and filler percentage. So far no laboratory results have been entered and these two fields are zero.

Press ENTER to view older samples. After the oldest sample, the information of the latest sample will be shown again. When the laboratory results of a sample are available, they should be entered to the device in the sample history display.

First select the sample for laboratory results will be entered. Then press EDIT/SAVE, and the cursor starts to blink in the laboratory consistency field. Enter the new value with the number keys and press ENTER, or just press ENTER to accept the existing value.

The filler percentage is entered next. If the pulp contains fillers, enter the proportional amount of filler as a percentage of total consistency. When these two fields contain the correct information, press EDIT/SAVE again to save the data in TCU's memory.

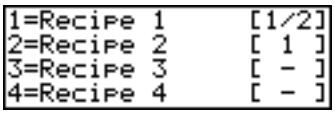
You can enter the laboratory results again, as many times as necessary. The samples can later on be used to calibrate the device, and then their laboratory values must be correct. Before calibration the samples are just stored in TCU’s memory and the laboratory values entered do NOT have any effect on the operation of the device.

Entering the filler content is optional if the transmitter is recalibrated each time the filler content changes. kajaaniROTARY does not measure fillers (ash). The transmitter is usually calibrated to indicate total consistency, by making the required sensitivity and/or zero offset correction in the calibration curve.

NOTE: The value for total filler sensitivity need only be entered with an accuracy of 5 % points. The filler components can also be entered based on an estimate.

6.6.6. Calibrate

Each one of kajaaniROTARY's recipes can be calibrated separately. When Calibrate is selected in the calibration display, you will first need to select the recipe to be calibrated:

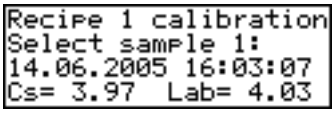


The recipe number is followd by a symbol inside brackets to indicate which calibration methods are available for this recipe:

- [1/2] both two point and single point calibrations are possible
- [1] only single-point calibration is possible
- [-] the recipe cannot be calibrated.

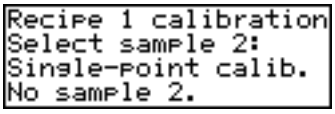
Single-point calibration requires that there must be at least one sample with laboratory consistency in TCU's memory, two-point calibration requires at least two samples with laboratory consistencies. If the device does not allow calibration, go to the sample history and check that laboratory consistencies have been entered for the samples that will be used in calibration.

When the recipe has been selected, the top two lines of the display will instruct you to select the first sample for recipe calibration:

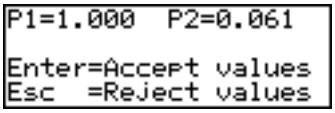


The two bottom lines show information on the samples. Use the UP and DOWN keys to select the samples, and then press ENTER when data on the correct sample is shown. The first calibration sample is now fixed. If more than two samples are available for calibration, kajaaniROTARY will then ask for the next sample.

For two-point calibration select a second sample in the same way. For single-point calibration no second sample is needed; see below.



When the samples have been selected, kajaaniROTARY performs calibration calculations and displays the results. Press ENTER to accept the values.



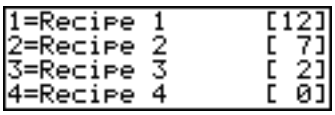
If the values of parameters P1 and/or P2 look suspiciously low/high, or if the difference between the two samples is less than 25 % of the consistency level, the display will show a warning of possible error but you can still choose to accept the calibration. If the values are extremely low or high, kajaaniROTARY will not accept the calibration parameters.

6.6.7. Calibration history

Max. 16 past calibrations are recorded in the calibration history table of each recipe. This calibration information can be viewed in the calibration history display.

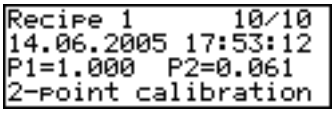
The device contains four recipes, each with a separate calibration history. First select the recipe before viewing calibration history data.

When "Calib. history" is selected in the calibration menu, the following display will appear:



In the recipe selection display for calibration history, the recipe number is followed by a number in brackets. This indicates how many calibrations have been stored in memory for this recipe.

When a recipe is selected, information on the latest calibration will be shown:

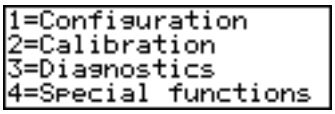


The first line shows the recipe number, the index of the current calibration, and the number of calibrations available for the recipe. The second line contains the calibration date and time. The third line contains the parameters P1 and P2 from the calibration. The fourth line shows whether single-point or two-point calibration was made.

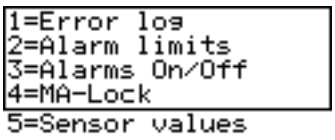
You can view older calibrations by pressing ENTER. After the oldest calibration, the latest calibration will be shown again.

6.7. Diagnostics

To access the diagnostics functions, press key 3 in the operations menu (TCU's main menu).



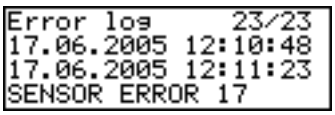
The following menu will appear:



Each of these functions is described below.

6.7.1. Error log

In the diagnostics menu, press key 1 to view the error log. Information on the latest error will be shown.



The first line shows the error index and the number of errors stored in the error log. The next two lines contain the starting and ending times of the error. If the error is still on or if the ending time was not detected, the ending timestamp is shown as '--.--.---- --:--:--'.

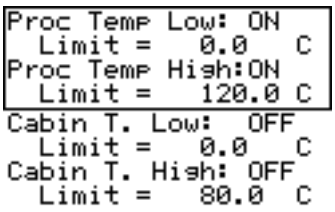
The message 'Shutdown' in the place of the error state end time indicates that the error state was on when power was shut down. If the error state is still on when the power is switched on next time, the error is reported as a new error. A text describing the error is shown on the last line.

The Error log contains the 96 most recent errors. You can view older errors by pressing ENTER. After the oldest error the latest error will be shown again.

6.7.2. Alarm limits

In the alarm limits display you can set some diagnostics ON/OFF and also set alarm limits for these diagnostics items.

The alarm limits display is shown below.



To change the alarm status and/or limit information, press EDIT/SAVE. The status values can be changed with the UP and DOWN keys. Alarm limit values can be entered with the number keys and the LEFT and RIGHT keys. Press ENTER to accept values.

Then press EDIT/SAVE to save and activate your selections. If you do not want to make any changes, press ESC to return to the previous menu level (to Diagnostics menu).

6.7.3. mA-Lock

This command locks the output signal to 4 mA, 20 mA, hold (present) value, or some other user-defined value. This command can be used to check the cabling and current measuring circuits.

In the Diagnostics menu, select "mA-Lock" (4). The following display will appear:

```
Output = 15.7 mA
1 = Set to  4 mA
2 = Set to 20 mA
UP/DOWN = modify
```

When this display is activated, the analog output is frozen to its present value, shown on the first line of the display.

- Press key 1 to set the analog output to 4 mA.
- Press key 2 to set the analog output to 20 mA.
- Pressing the UP and DOWN keys to increase and decrease the analog output value.

Press ENTER or ESC to return the analog output to normal (= what it was when the display was activated).

6.7.4. Sensor values

The sensor values display contains some raw measurement information from the sensor. This information is primarily needed in order to detect faults that are hard to find without detailed knowledge of device operation, and is not needed for normal operation.

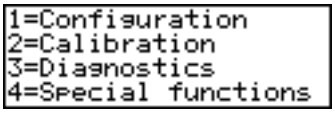
```
Ratio     = 0.27837
Raw ratio = 0.30146
Coil PWM  =   17238
Coil curr.=   0.319
Ref. High =   13986
Ref. Low  =   15264
Sum High  =  753595
Sum Low   = 1716949
Meas curr =   15387
Proc temp = 1072348
Elec temp = 1075815
```

This information cannot be changed by the user. The data in this display:

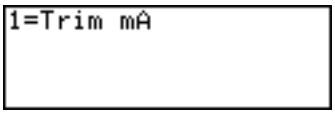
Ratio	measured and temperature compensated pulse ratio of the toothing
Raw ratio	measured pulse ratio of the toothing without temperature compensation
Coil PWM	output to current D/A-converter of coil
Coil current	measured coil current, amps
Reference high	length of the reference tooth high-portion
Reference low	length of the reference tooth low-portion
Sum high	sum of the high-portions of all the teeth of a cycle
Sum low	sum of the low-portions of all the teeth of a cycle
Measured current	measured coil current raw value from A/D-converter
Process temperature	measured process temperature raw value from A/D-converter
Electronics temperature	measured electronics temperature raw value from A/D-converter

6.8. Special functions display

To access the special functions, press key 4 in the TCU's main menu.



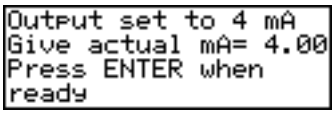
The following menu will appear.



This menu contains onlyone function: trim mA output.

6.8.1. Trim mA

This function requires that you connect an ammeter to the transmitter's analog output. The transmitter will first send a 4 mA signal to the analog output, and the display will read:

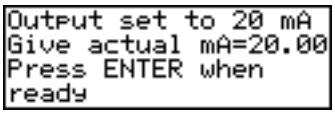


Measure the actual current value and enter it to the device with the keypad. To change the value, press EDIT/SAVE and the first character of the current value starts to blink. Enter the measured current with the number keys. Example: to enter the value 3.98 mA use the following key sequence:

3 . 9 8 ENTER

If you do not want to make any changes, press ESC to return to the previous menu level (Special functions menu).

Press ENTER to accept the value. The transmitter then sends a 20 mA signal to the analog output, and the display will read:



Measure the actual current value and enter it to the device with the keypad. To change the value, press EDIT/SAVE and then enter the measured value as instructed above for the 4 mA signal.

7. Maintenance and diagnostics

NOTE: Before removing the transmitter from process, make sure that the process pipe is empty and unpressurized and that it is safe to proceed.

7.1. Regular inspection

- Check transmitter performance regularly by laboratory samples.
- Check the flushing water supply once a week. If the flushing water is colored by process chemicals or contains fibers, or if the flow is blocked, take action to correct the situation.
- Check the condition of the drive belt every six months. Change it if it is cracked or damaged. A temporary split belt is available for emergency repairs.
- If pH at the transmitter's installation point is very high or low, check the condition of the measuring shaft O-ring seal every year.
- Make sure that the transmitter or TCU are not exposed to abnormal vibration or splashes; these may deteriorate their performance and complicate repairs and servicing.

After initial start-up and calibration, monitor the transmitter's operation regularly with samples and readjust zero level when required. All actions should be recorded in the transmitters' service log.

7.2. Long term field service

- Changing the belt pulley(s) and drive belt after five years.
- Changing the mechanical seal after five years depending on circumstances.
- Changing the rubber seals after five years.

7.3. Process conditions

The kajaaniROTARY is inserted into the pipe, and therefore it should not be installed in a place where the pulp may contain strings or other material that may become wrapped around the sensing element. If some material is entangled in the sensor body, the measurement results tend to drift upwards.

The speed of the drift is directly dependent on how rapidly the extra material builds up around the sensor, and it may sometimes occur very quickly. The sensor must be removed from the process coupling for checking.

7.4. Self-diagnostics

The transmitter monitors its own operation continuously. Any detected faults are shown in error messages that can be read from the transmitter's TCU or from serial I/O (HART® ¤).

kajaaniROTARY's self-diagnostic function monitors the internal measurements and generates error messages if the measurements exceed certain alarm limits. An erroneous measurement result may also be due to contamination or some process variable that is skewing the measurement. Self-diagnostics may not detect such a fault. Self-diagnostics also detects definite faults which can be caused by sensor electronics.

Self-diagnostics monitors the signal of the measurement channel measuring the process. Self-diagnostics is capable of detecting clear fault states, and in such a case it generates an alarm by freezing the current signal or setting it to 3.75 or 22.5 mA, according to user specifications. User can also switch the alarm current OFF (by selecting alarm current = NONE in TCU's current output configuration display).

However, self-diagnostics may not necessarily be able to detect problems such as a drift in the measurement, that are not obvious device faults.

Self-diagnostics measures the following values:

- Pulses produced by optosensor.
- Rotation frequency of the sensing unit.
- Coil current.
- A/D-converter of the sensor unit.
- Memory (EEPROM) operation in the sensor unit and TCU.
- Communication between TCU and sensor unit.
- TCU's clock.
- HART communication.
- Current (mA) output.
- Values of consistency, torque, process temperature and electronics temperature.

The fault may also be in the current output sent by the TCU. In this case the measurement is correct, but the current output sent to the automation system is incorrect. The following figure contains a troubleshooting chart for faults that appear in different ways.

¤) only for kajaaniROTARY MA

7.5. Error messages

Select **Error log**in the **DIAGNOST** menu.

Serious faults/errors:

The following faults are so serious that the transmitter's normal operation is terminated and an error current gives an error alarm (3.7 mA or 22.5 mA, depending on ALARM TYPE selection) if selected in Diagnostics Diag. Alarms.

Less serious faults/errors. These faults will not trigger the error current:

Error message	Description
AD ERROR	AD converter error. Conversion restarted.
HART ERR	Higher-level HART® communication error ¤).

¤) only for kajaaniROTARY MA

Warnings and error messages during operation:

7.5.1. Measurement error messages

Sensor electronics failures

In most cases the self-diagnostics detects the fault and gives the corresponding alarm. The following errors or malfunctions in the measurement unit are detected and displayed in TCU.

Error message	Description
ERROR: NO PULSES	No pulses from notched wheel, motor not running or defective electronics.
ERROR: PULSE TIMING X	Pulses detected by notched wheel are too long or too short.
ERROR: FREQUENCY	Frequency of motor < 45 Hz or > 65 Hz.
ERROR: MECH. LIMIT	Measurement shaft hit to mechanical limit.
ERROR: COIL CURRENT X	Problems with magnetic coil circuitry (open circuit, short circuit or current out of limits).
ERROR: SENSOR ADC X	AD converter error or converted AD value is out of error limits.
ERROR: SENS. EEPROM X	Non-volatile memory (EEPROM) fault in sensor unit.
ERROR: SENSOR COMM. X	Error in communication between TCU and sensor unit.
FACTORY CALIBRATION	Sensor unit parameters are lost, default values are used.

7.5.2. TCU error messages

Error message	Description
ERROR: NO SENSOR	No response from sensor unit to TCU.
ERROR: TCU EEPROM	Non-volatile memory (EEPROM) fault in TCU.
ERROR: CLOCK	Error in TCU's clock.
ERROR: HART X	Error in HART communication to TCU.

7.5.3. Warning messages

Warning message	Description
DEFAULT CALIBRATION	The device has not been calibrated, default calibration parameters are used.
CLOCK NOT SET	TCU's clock is not set.
OUTPUT SATURATED	mA output is out of range.
FIXED mA OUTPUT	mA output fixed, does not indicate consistency.
UNKNOWN SENS.ELEMENT	Sensing element is not set, default TM sensor parameters are used.
CS OUT OF LIMITS	Consistency is out of range.
TORQUE OUT OF LIMITS	Torque is out of range.
PROC.T OUT OF LIMITS	Process temperature is out of range.
ELEC.T OUT OF LIMITS	Electronics temperature is out of range.

7.6. Troubleshooting

Rough categorization of the problems:

1. Substantial difference between kajaaniROTARY consistency reading and laboratory results.
2. HART ® interface is not operating properly.
3. Consistency reading is not responding to consistency.

Check which one of the preceding conditions is ON and read the corresponding section below.

7.6.1. Substantial difference between kajaaniROTARY consistency reading and laboratory results

The device is measuring in the normal manner and responding to consistency, but there is a substantial difference between kajaaniROTARY's consistency reading and laboratory results.

The most common causes for this error:

- Wrong recipe parameters.
- A change in pulp type or mix proportion.
- The pulp contains fillers whose amount varies.
- kajaaniROTARY has not been installed as instructed.
- Flow velocity is below/above the specified limit.
- The consistency level is not suitable for the sensing element used.
- A change in fiber properties.
- Accumulations of pulp on the sensing element surface. Remove the transmitter from the process.

7.6.2. HART ® interface is not operating properly

The transmitter is operating correctly except for the HART ® interface.

- Is the current measuring resistor’s rating at least 250 Ω ?
- Considering the total load, is the supply voltage sufficiently high? Also measure the voltage and current from the transmitter’s terminal blocks. Is the terminal voltage above 11V? Does HART® operate at any current? Disconnect the transmitter’s supply, then reconnect it. Did HART® start operating?

7.6.3. Consistency reading is not responding to consistency

Check 1:
Is the transmitter rotating and is there water or pulp around the sensing element?

Check 2:
Check coil current output: go to the TCU main menu, select 3=diagnostics, then 4=sensor values. Is coil PWM very small (about 10) or very large (about 65525)?

YES: Coil current seems to be at the limit. A likely reason is a problem with the optosensor pulse ratio controller. Try to restart the transmitter and check if the problem disappears. If the problem still remains, the transmitter requires factory service.

Check 3:
Check the coil current measurement in the **sensor values** display. Is coil curr. zero or about 0.7 (or higher)?

YES: Probably the problem is in the coil current A/D conversion. Restart the transmitter and check if the problem disappears. If the problem still remains, the transmitter requires factory service.

Check 4:
Check the torque. Is the torque either zero, exactly the same as coil current, or higher than 1.2 Nm?

Parameters for the conversion from coil current to torque are wrong. Restart the transmitter and check if the problem disappears. If the problem still remains, the transmitter requires factory service.

Check 5:
Check the recipe parameters.

The torque seems to be OK, but there is something wrong with the conversion of torque into a consistency value.

P1 should be about 1.0.
P2 should be about 0.0.

7.7. Checking the operation of force measurement and current output

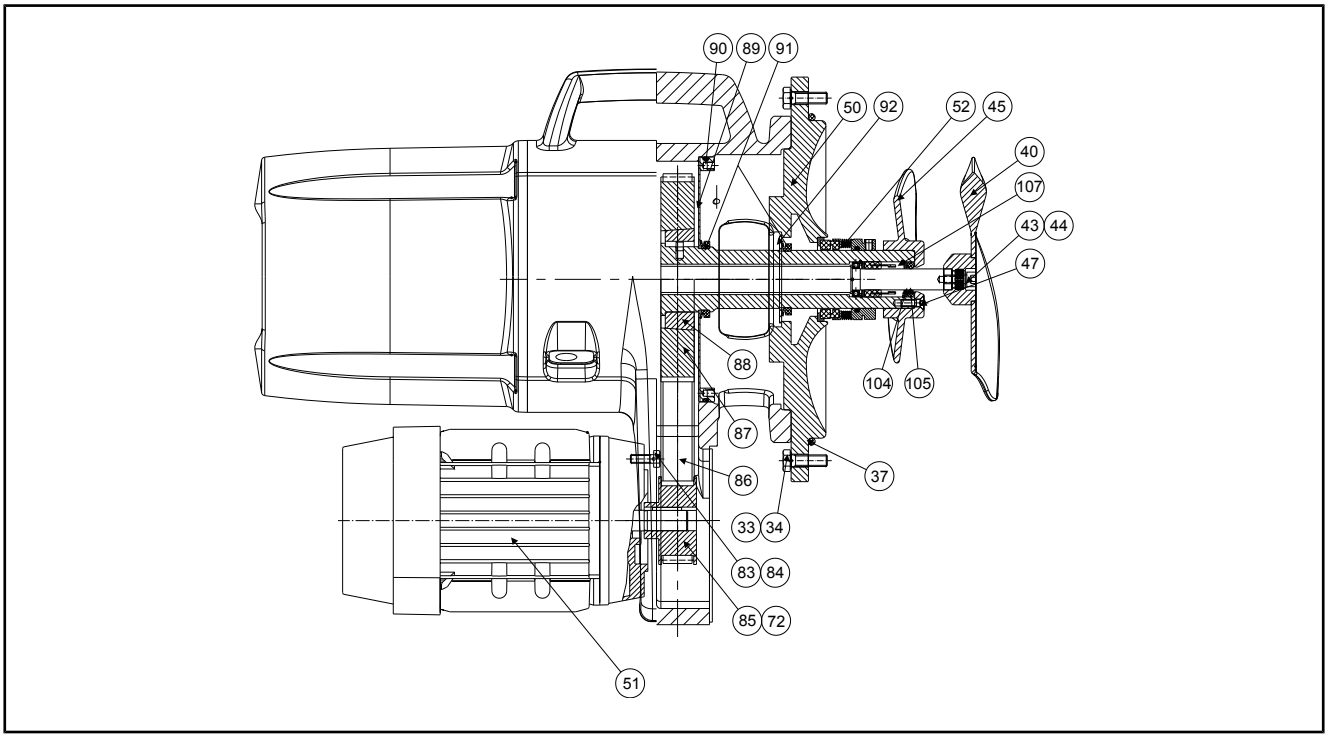
A normal, regular consistency calibration will rectify the effect of force measurement zero drift on consistency measurement.

kajaaniROTARY calculates and displays the consistency (shear force) and mA output in digital format. The actual conversion of the digital value to a 4–20 mA output current is done by using factory-calibrated D-to-A conversion electronics. This system is very stable and thus the output current normally need not be trimmed.

However, the transmitter is provided with the **TRIM MA ¤)**function for trimming the mA output display. The TRIM MA ¤) function requires connecting an accurate, calibrated ammeter to the transmitter's output. While the transmitter gives out two current values, the actual current can be precisely measured and the transmitter readings corrected accordingly, if necessary.

MA LOCK ¤) This command locks the output signal to its present value and displays the mA value instead. You can then change the mA value with the arrow keys as desired. This command can be used to check the cabling and current measuring circuits.

¤) only for kajaaniROTARY MA



7.8.1. Replacing the drive belt and pulleys

- Unscrew the socket head screw (43) and detach the sensing element (40).
- Unscrew the three socket head screws (47) and detach the mixing propeller (45).
- Loosen the set screws of the mechanical seal (52) and remove the rotating part of the seal. Do not apply force on the bellows part of the seal!
- Unscrew the flush water connection pipes of the seal.
- Unscrew the six socket head screws and detach the connection flange (50).
- Remove V-ring seal (91).
- Unscrew the two belt guard set screws from the bearing body shell, and detach belt guard (89).
- Unscrew the four socket head screws and detach the inspection cover.
- Unscrew the two set screws from the Taper-lock bushing (88) of the drive shaft pulley. Then insert one of the two screws into the third Taper-lock bushing hole and tighten it to disassemble the bushing. Detach the bushing and the drive shaft pulley (87).
- Remove belt (86).
- Unscrew the socket head set screw (72) from engine shaft pulley. Detach the pulley from motor by inserting two M6 screws into the holes on the face and tightening them.

Prior to assembly assess the condition of all mechanical parts and seals:

– Check and clean the connection flange.
– Check and clean the flush water pipes.
– Check the drive shaft for any sharp edges, grind marks and scratches, and polish it if necessary.

Assembling:

- Remove cover plate (92) and the mechanical seals (52) seat from connection flange. NOTE! The silicone carbide seat is fragile.
- Insert the new pulley (85) to the motor shaft. Press it against the shaft collar and secure it with a socket head set screw (72).
- Insert the new belt to the drive shaft and fit the belt to the motor shaft pulley (85).
- Insert drive shaft pulley (87) without the Taper-lock bushing (88) into the bearing body, and place the belt around it.
- Insert the bushing into pulley and press it against the drive shaft collar. Tighten the two Taper-lock hub screws.
- Mount the inspection cover and secure it into place with four socket head screws.
- Mount the belt guard (89) and secure it into place with two set screws.
- Insert the V-ring seal (91) onto the drive shaft and assure that the seal lip is pressed against the belt guard.
- Insert cover plate (92) into the process flange, press down until it snaps into place.
- Insert the connection flange (50) into the bearing body and secure it with the six socket head screws. Make sure to align the nipples of the flushing water pipe horizontally.
- Insert V-ring seal (91) against the cover plate (92), by sliding it down the drive shaft until the seal drops into it groove.
- Insert the mechanical seals seat into the connection flange. Use soapy water for lubrication.
- Mount the mechanical seal (52) and secure with two screws. Installation length for MFL85N is 31 mm ± 0.5 mm, for HJ 977 it is 34.5 mm ± 0.5 mm.
- Mount the mixing propeller (45) and secure it with three socket head screws (47).
- Mount the sensing element (40) and secure it with socket head screw.
- Mount the seal flush water piping, complete with thread sealant.

All screws must be secured with Loctite 243 or equivalent thread lock.

7.8.2. Replacing the mechanical face seal

- Unscrew the socket head screw (43) and detach the sensing element (40).
- Unscrew the three socket head screws (47) and detach the mixing propeller (45).
- Loosen the set screws of the mechanical seal (52) and remove the rotating part of the seal. Do not apply force on the bellows part of the seal!
- Unscrew the flush water connection pipes of the seal.
- Unscrew the six socket head screws and detach the connection flange (50).
- Remove the seat and cover plate (92) from the connection flange.

Prior to assembly assess the condition of all mechanical parts and seals:

– Check the connection flange, and clean off any pulp discharge that may be found if the mechanical seal has leaked.
– Check and clean the flush water pipes.
– Check the drive shaft for any sharp edges, grind marks and scratches, polish it if necessary.
– Change any worn or damaged parts.

Assembling:

- Insert the cover plate (92) into the connection flange. Soapy water may be used for lubrication.
- Insert the connection flange (50) into the bearing body and secure it with the six socket head screws. Make sure to align the nipples of the flushing water pipe horizontally.
- Insert V-ring seal (91) against the cover plate (92), by sliding it down the drive shaft until the seal drops into it groove.
- Insert the mechanical seals seat into the connection flange. Use soapy water for lubrication.
- Mount the mechanical seal (52) and secure it with the two screws. Installation length for MFL85N is 31 mm ± 0.5 mm, for HJ 977 it is 34.5 mm ± 0.5 mm.
- Mount the mixing propeller (45) and secure it with three socket head screws (47).
- Mount the sensing element (40), secure with socket head screw.
- Mount the seal flush water piping, complete with thread sealant.

All screws must be secured with Loctite 243 or equivalent thread lock.

7.8.3. Replacing the flange V-ring seal and cover plate

- Unscrew the socket head screw (43) and detach the sensing element (40).
- Unscrew the three socket head screws (47) and detach the mixing propeller (45).
- Loosen the set screws of the mechanical seal (52) and remove the rotating part of the seal. Do not apply force on the bellows part of the seal!
- Unscrew the flush water connection pipes of the seal.
- Unscrew the six socket head screws and detach the connection flange (50).
- Remove the cover plate (92) and mechanical seal seat from the connection flange. NOTE! The silicone carbide seat is fragile.

Prior to assembly assess the condition of all mechanical parts and seals:

– Check and clean the connection flange.
– Check and clean the flush water pipes.
– Check the drive shaft for any sharp edges, grind marks and scratches, polish it if necessary.
– Change any worn or damaged parts.

Assembling:

- Insert the cover plate (92) into the connection flange.
- Insert the connection flange (50) into the bearing body and secure it with the six socket head screws. Make sure to align the nipples of the flushing water pipe horizontally.
- Insert V-ring seal (91) against the cover plate (92), by sliding it down the drive shaft until the seal drops into it groove.
- Insert the mechanical seals seat into the connection flange. Use soapy water for lubrication.
- Mount the mechanical seal (52) and secure it with the two screws. Installation length for MFL85N is 31 mm ± 0.5 mm, for HJ 977 it is 34.5 mm ± 0.5 mm.
- Mount the mixing propeller (45) and secure it with three socket head screws (47).
- Mount the sensing element (40), secure with a socket head screw.
- Mount the seal flush water piping, complete with thread sealant.

All screws must be secured with Loctite 243 or equivalent thread lock.

7.8.4. Replacing the measuring shaft O-ring seal

- Unscrew the socket head screw (43) and detach the sensing element (40).
- Unscrew the three socket head screws (47) and detach the mixing propeller (45).
- Wrench out the O-ring (105) using a screwdriver or a knife.
- Pry out the washer (104) and inspect the space in front of the secondary seal. If process media has leaked past the O-ring (105) and the secondary bushing appears puffed, it must be replaced. A complete repair of the secondary bushing can only be done in Metso Automation's service point in Tampere, Finland.

Assembling:

- Insert the washer (104) into the drive shaft chamber.
- Insert the new O-ring into the drive shaft chamber. Do not twist it torsionally!
- Mount the mixing propeller (45) and secure it with three socket head screws (47).
- Mount the sensing element (40), secure with a socket head screw.
- Mount the seal flush water piping, complete with thread sealant.

All screws must be secured with Loctite 243 or equivalent thread lock.

7.8.5. Replacing the TCU

Removing:

1. Switch off the mains voltage from the TCU and disconnect the mains power lines from TCU's terminal block.
2. Disconnect the sensor cable and the factory system cable from the TCU terminal block.
3. Detach the TCU from the shield.

Installing:

1. Attach the new TCU to the shield.
2. Connect the sensor cable, power cable and factory system cable to the TCU terminal block.
3. Switch on the mains power to the TCU.

NOTE: It may take a few minutes before text appears on the display. This delay is caused by the charging of the internal back-up battery and is perfectly normal.

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4. If the program asks you to select the calibration, select

– sensor electronics calibration if you did not replace any sensor electronics.
– default calibration if you have replaced sensor electronics as well.

8. Applications

The kajaaniROTARY transmitter is used for consistency measurement in the pulp and paper industry. The transmitter is installed directly in the stock line.

kajaaniROTARY is supplied with an operating unit, a sensor to suit the process application, a process coupling, a process gasket, and a deflector plate.

8.1. Applications of the different sensing element types

kajaaniROTARY is supplied with a variety of optional sensing elements. The choice of an element is mainly dictated by the consistency and type of fiber.

The list shows the consistency ranges best suited for the different sensor options and pulp types. See Appendix 1, Technical specifications.

The Consistency Advisor PC program, supplied by Metso Automation, can also be used to select the best sensor element. The program also calculates and prints the required minimum lengths of straight pipe sections on both sides of the installation point.

When the transmitter is installed according to the instructions, the effect of flow velocity variations on result accuracy will be negligible in the recommended measurement ranges.

9. Recycling and disposal of a device removed from service

Most device parts are recyclable when sorted according to their material. A materials list must accompany the device. The device manufacturer can supply you with recycling and disposal instructions.

You can also return the device to the manufacturer for recycling and disposal; this procedure involves a recycling fee.

Appendix 1 - Technical specifications

kajaaniROTARY™ consistency transmitter is used for pulp consistency measurement in the pulp and paper industry. The transmitter's operating principle is based on shear force measurement and it is installed directly to the process pipe.

The transmitter is supplied with an operating unit (TCU). The sensing element is selected based on the pulp type and the measured consistency range. The optional mounting chamber/process coupling is selected based on process pipe diameter and pressure rating.

Main features:

Measuring range	1.5–18 %Cs
Span min.	0.5 %Cs
Repeatability	±0.01%Cs
Sensitivity	0.001 %Cs
Damping	adjustable 1 to 60 s

Environmental specifications:

Ambient temperature	-20...+70°C, -4…+158°F
Storage temperature	-50…+80°C, -50…+176°F

Transmitter:

Enclosure class	IP66 (NEMA 4X)
Enclosure material:	Aluminum

Material of wetted parts:
- AISI 316L (std)
- 254 SMO®
- Hastelloy C-276

Sealing:	EPDM/Kalrez

Motor:

Enclosure class	IP55 (optional IP56)
Power:	0.36 kW
Supply voltages:	200–690 VAC / 45–65 Hz

See table 2 for motor type selection.

Operating unit, TCU:

Enclosure class	IP 65 (NEMA 4)
Operating voltage	90–260 VAC / 25 W

Outputs:
- Current output: 4–20 mA + HART® 18–35 VDC
- Profibus PA

Inputs: 2 galvanically isolated binary inputs for recipe selection or sampler status (12–28 VDC / 10 mA)
Cable length: 10 m/33 ft (30 m/98 ft as option)

Configuration and diagnostics tools:
- DTM for FieldCare™
- AMS
- Field communicator or control system using HART communication protocol

Process specifications:

Process temperature	0...+120°C / +32...248 °F
Flow velocity	0.3–5 m/s

Process rating
- PN10/150 lbs.
- PN25/363 lbs.

Vibration	Max. 2g(20 m/s^2), 10–2000 Hz

Table 1. Sensors and consistency ranges (min/max) by pulp types.

Pulp type	Chemical pulp		Mechanical pulp			Recycled pulp	
Sensor	**HW**	**SW**	**TMP**	**GW**	**CTMP**	**DIP**	**OCC**
TM	1.6-7	1.5-6.5	1.7-7	1.7-7	1.7-7	1.8-8	1.8-8
PL	5.5-12	5-11	6.5-13	6.5-13	6.5-13	7-13	7-13
PM	7.5-14	7-13	8-14	8-14	8-14	8.5-14	8.5-14
PH	10-16	9-15	11-16	11-16	11-16	12-18	12-18

Appendix 1 - Technical specifications

Weights and sizes:

Transmitter	35 kg (PN25 38kg)
Total package size (WxHxD)	60x75x40 cm
Total package weight	45 kg (PN25 48 kg)

EMC test standards:
Radiated interference: EN 50081- 1: 1993
Interference immunity: EN 50082 -2: 1995,
EN 61326: 1997 - Industrial locations

Sealing water requirements

- Pressure: 0.5–9 bar
- Flow rate: 0.5–1 l/min
- Temperature: max. 60 C
- Quality: no impurities, particle size < 200 µm

Table 2. Motor voltages and connections.

Frequency	50 Hz		60 Hz	
	Voltage (VAC)		Voltage (VAC)	
Motor type	Delta	Star	Delta	Star
MS	220-240	380-420		440-480
MD	380-420	660-690	440-480	
MF*		500-550		550-575
MX**			200-220	

* non standard, CSA safety certificate available on request

** non standard, also available for other voltage or frequency ratings on request

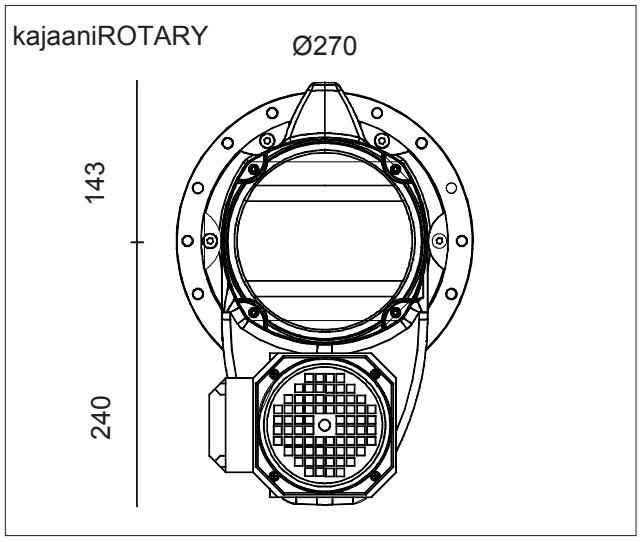
Options

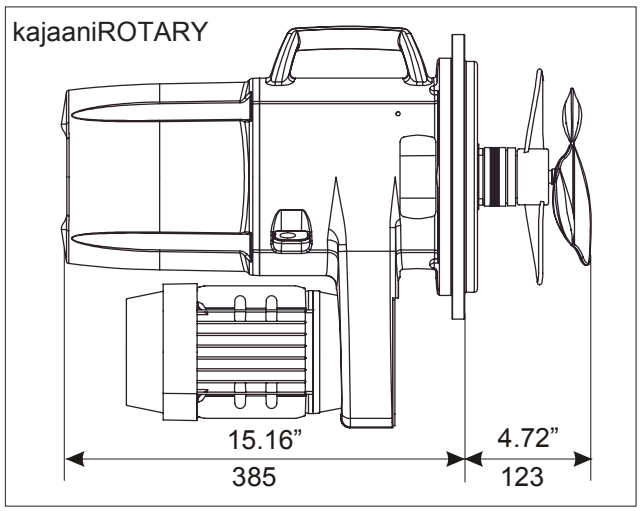
Table 3. Mounting chamber and process couplings.

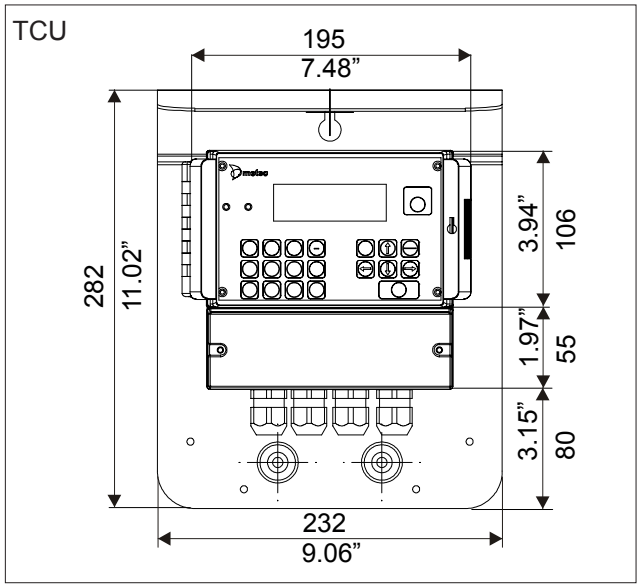
Mounting chamber	Process coupling	
PN10	PN10	PN25
Pipe size	Pipe size	Pipe size
DN100	≥DN300	DN200 ***)
DN150		≥DN250
DN200		
DN250		

***) Only for MC-consistencies.

Dimensions:

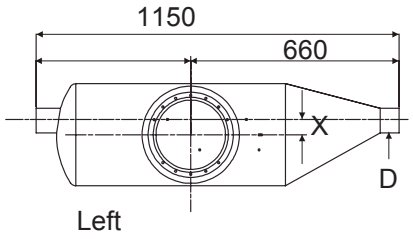


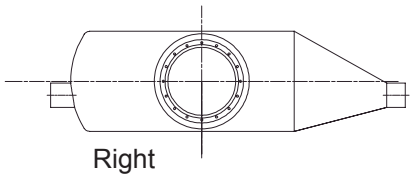




Appendix 1 - Technical specifications

Options: Mounting chamber and process coupling: horizontal and vertical installation (PN10)

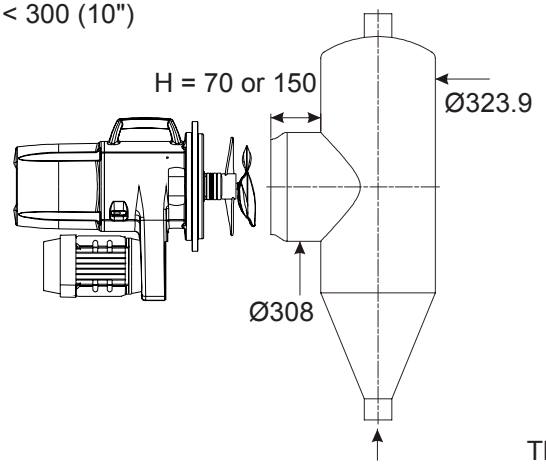




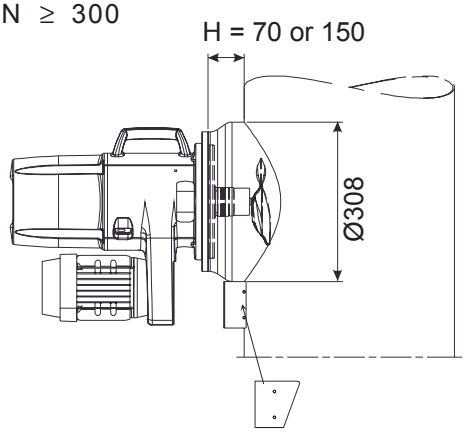
DN	D / mm	X / mm
100/4"	144.3	67
150/6"	168.3	39
200/8"	219.1	13.5
250/10"	273	0

H = 150	when %Cs < 5
H = 70	when %Cs > 5

For DN < 300 (10")



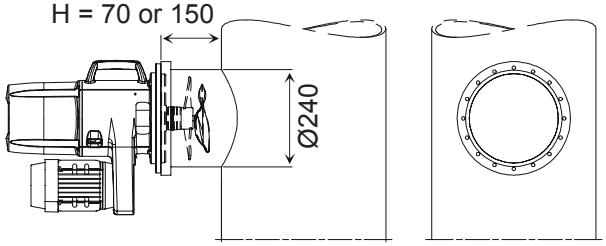
For DN ≥ 300 (10")



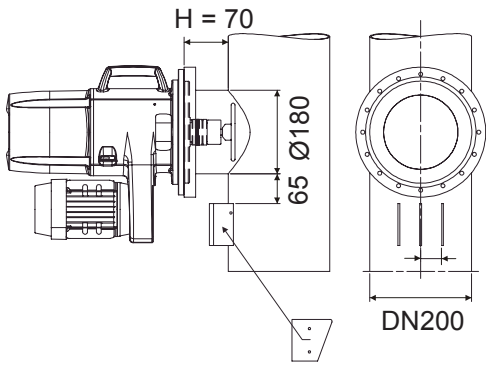
The three deflector plates supplied should be welded when the length of the process coupling is 70 mm (2.57").

Options: Process coupling: horizontal and vertical installation (PN25)

For DN ≥ 250 (10")



For DN 200 (8") ***)



***) Only for MC-consistencies.

Appendix 1 - Technical specifications

kajaaniROTARY™ type codes (ordering codes) for transmitters

Transmitter

Product	Communication	Sensing element	Wetted parts	Pressure rating	Motor type
kajaaniROTARY	**MA**	**TM**	**SS**	**J**	**MS**

ma+HART: MA
Profibus PA: PA

1.5-6 %Cs: TM
5-10 %Cs: PL
8-12 %Cs: PM
10-18 %Cs: PH

AISI 316: SS
254 SMO®: SMO
Hastelloy C-276: HC

PN10: J (only SS)
PN25: L

220-480 VAC: MS
690 VAC: MD
550-575 VAC: MF
200-220 VAC: MX

NB: Consistency ranges for specific sensing element are typical, as well as voltage ranges for different motors. For selection of mounting parts, refer to document Mounting parts for kajaaniROTARY.

metso automation

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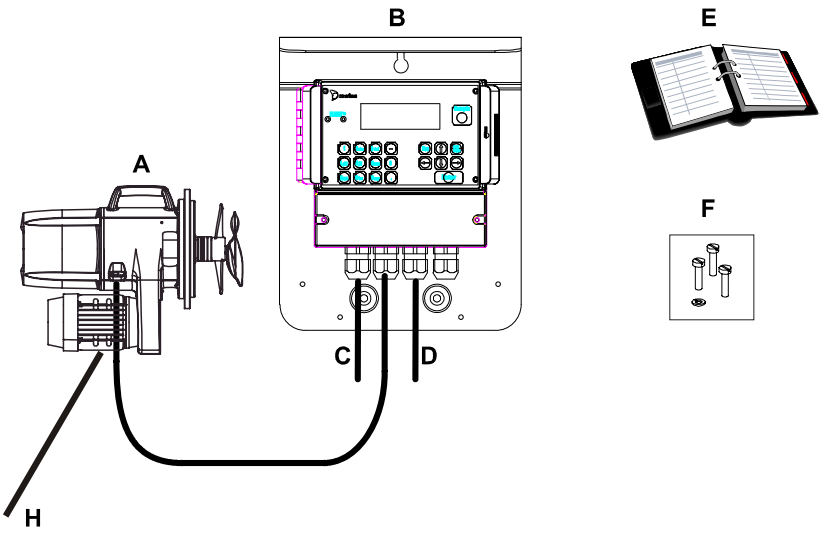
Appendix 2 - Delivery content



Metso delivers:

Name	Symbol
Sensor Unit *)	A
kajaaniROTARY Transmitter Central Unit with a 10m sensor cable	B
Mounting set	F
Installation, operation and service manual	E

Customer delivers:

Power supply cable 90–260 VAC	C
Power supply cable for the motor	H
Signal cable to DCS	D

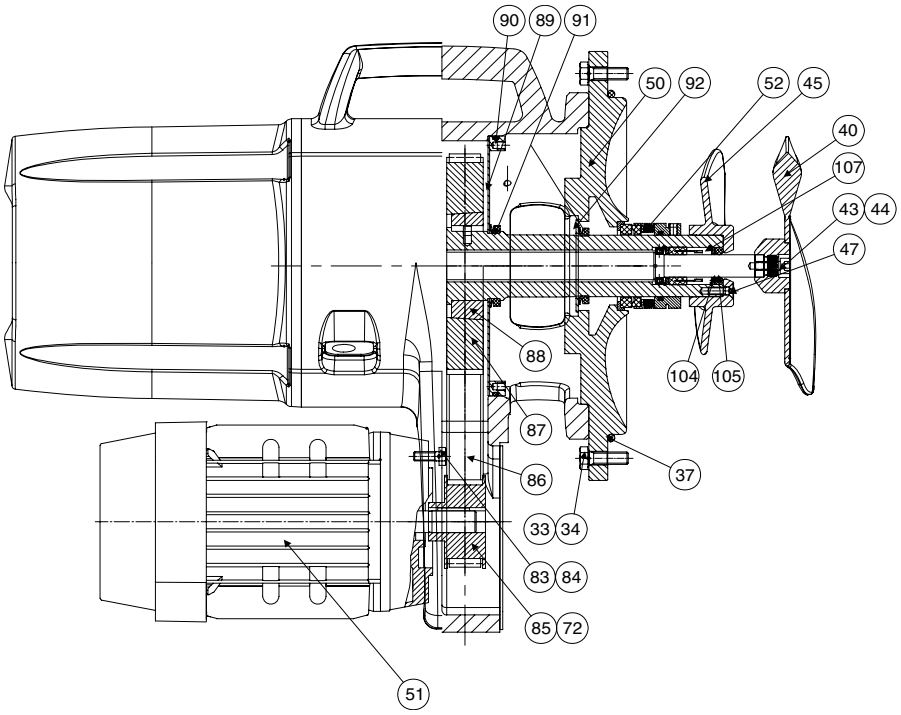
*) Sensor unit options, refer to Technical specifications T00359EN

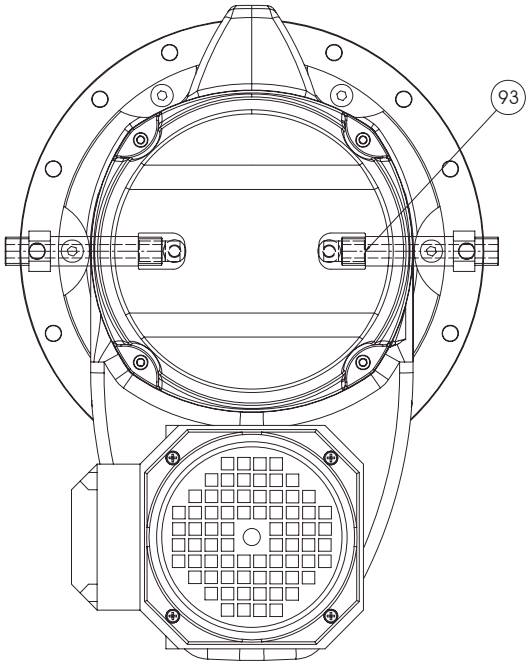
AISI 316
SMO® 254
Hastelloy C-276

Options:

OUL00363	Sensor cable 30 m / 98 ft
	Mounting chamber, refer to document Mounting parts for kajaaniROTARY.
	Process coupling, refer to document Mounting parts for kajaaniROTARY.

Appendix 3 - Spare parts





Appendix 3 - Spare parts

Sensor unit spare part sets:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
32	MOUNTING SET	T00439	J (PN10/150 lbs)		1
33	Hexagon screw	K0274	M8X25 DIN933	ISO 3506 A4-80	15
34	Washer	135608	8.4 DIN125	AISI 316	16
35	Stud	T00433	M8X40 DIN939	ISO 3506 A4-80	1
36	Hexagon nut	56022800	M8 DIN934	ISO 3506 A4-80	1
32	MOUNTING SET	T00573	L (PN25/363 lbs)		1
33	Hexagon screw	T00590	M10X35 DIN933	ISO 3506 A4-80	15
34	Washer	162958	10.5 DIN125	AISI 316	16
35	Stud	T00591	M10X45 DIN939	ISO 3506 A4-80	1
36	Hexagon nut	56022810	M10 DIN934	ISO 3506 A4-80	1
93	PIPE ASSEMBLY	T00379			1
94	Elbow fitting	K0226	1/4 NPT	AISI 316	2
95	Restricter	T00415		RUBBER	1
96	Pipe	T00414	FLUSHING	AISI 316	2
97	Y-fitting	T00417	G 1/4	AISI 316	1
98	Cap nut	T00418	G 1/4	AISI 316	1
99	Flow direction arrow	85548188			1
100	Hose coupling	04053000	1/4X13		1
	SPARE PART SET	T00862	SEALS		1
37	O-ring	T00363	215.27X5.33	EPDM	1
90	O-ring	T00362	160X3	EPDM	1
91	V-ring	T00357	VA 40	Viton	2
92	Cover plate	T00824	VRWS 42X60 MM		1
105	O-ring	T00822	13.64X5.33	EPDM	1
	SPARE PART SET	T00615	POWER TRANSMISSION		1
72	Socket head screw	T00386	M5X10 DIN914	AISI 316	1
85	Belt roller	T00371	22-8M-20	Aluminum	1
86	Belt	T00366	656-8M-20	Rubber	1
87	Belt roller	T00372	56-8M-20	Aluminum	1
88	Taper bush	T00373	2012/45 L=20	Aluminum	1

Appendix 3 - Spare parts

Sensor unit spare part sets:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
37	O-ring	T00363	215.27X5.33	EPDM	1
40	Sensing element				1
		T00826	TM SS	AISI 316	
		T00827	PL SS	AISI 316	
		T00828	PL SMO	SMO® 254	
		T00829	PL HC	Hastelloy C-276	
		T00830	PM SS	AISI 316	
		T00831	PM SMO	SMO® 254	
		T00832	PM HC	Hastelloy C-276	
		T00833	PH SS	AISI 316	
		T00834	PH SMO	SMO® 254	
		T00835	PH HC	Hastelloy C-276	
43	Socket head screw				1
		197707	M6X20 DIN912	AISI 316	
		T00552	M6X20 DIN912	SMO® 254	
		T00553	M6X20 DIN912	Hastelloy C-276	
44	Lock washer				1
		5060024	DIN6798-A6.4	AISI 316	
		T00554	6.4 DIN6798 A	SMO® 254	
		T00555	6.4 DIN6798 A	Hastelloy C-276	
45	Propeller				1
		T00799	TM SS	AISI 316	
		T00805	MC SS	AISI 316	
		T00806	MC SMO	SMO® 254	
		T00807	MC HC	Hastelloy C-276	
47	Socket head screw				3
		01101908	M5X16 DIN7991	AISI 316	
		T00550	M5X16 DIN7991	SMO® 254	
		T00551	M5X16 DIN7991	Hastelloy C-276	
50	Flange				1
		T00808	SS J (PN10/150 lbs)	AISI 316	
		T00809	SS L (PN25/363 lbs)	AISI 316	
		T00810	SMO L (PN25/363 lbs)	SMO® 254	
		T00811	HC L (PN25/363 lbs)	Hastelloy C-276	

Appendix 3 - Spare parts

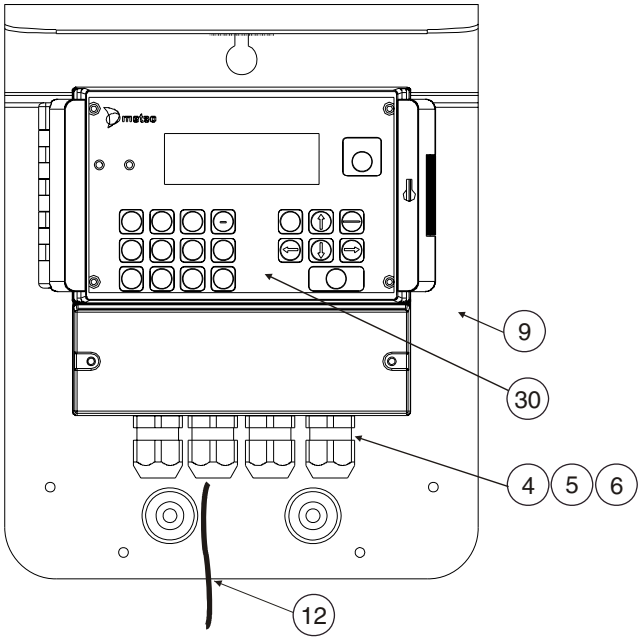
Sensor unit spare parts:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
51	Electric motor				1
		T00317	MS	230/380/440VAC motor	
		T00318	MD	690 VAC motor	
		T00562	MF	500 VAC/50Hz, 575/60Hz	
		T00563	MX	200 VAC/60Hz	
		T00616	MF+C	MF with CSA approval	
		T00617	MS+T	IP56 certified motor	
		T00618	MD+T	IP56 certified motor	
		T00619	MF+T	IP56 certified motor	
		T00620	MF+CT	CSA + IP56 certified motor	
		T00621	MX+T	IP56 certified motor	
		T00622	MS+H	High temperature model	
		T00623	MD+H	High temperature model	
		T00624	MF+H	High temperature model	
		T00625	MF+CH	CSA + High temperature model	
		T00626	MX+H	High temperature model	
		T00627	MS+TH	IP56 + High temperature model	
		T00628	MD+TH	IP56 + High temperature model	
		T00629	MF+TH	IP56 + High temperature model	
		T00630	MF+CTH	CSA + IP56 + High temperature model	
		T00631	MX+TH	IP56 + High temperature model	
52	Mechanical seal				1
		T00355	SS MFL85N/40-G60	Type A	
		T00592	HC MFL85N/40-G60	For SMO® 254 and Hastelloy C-276 sensor units	
		T00593	SS HJ977GN10/40	Type B	
		T00594	HC HJ977GN10/40	For SMO® 254 and Hastelloy C-276 sensor units	
83	Hexagon screw	155812	M6X16 DIN933	AISI 316	4
84	Washer	50002610	M6/6.4 DIN125	AISI 316	4
86	Belt				1
		T00366	656-8M-20	Rubber	
		T00596	TEMPORARY	Rubber	
89	Protective plate	T00389		AISI 316	1
107	Locking ring	T00821	24X1 DIN472	AISI 304	1

Appendix 3 - Spare parts

Transmitter Central Unit spare parts:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
30	Operating unit	OUL00377	TCU (ROTARY)	mA+HART® Version	1
12	Cable assembly				1
		OUL00362	TCU Sensor cable 10M		
		OUL00363	TCU Sensor cable 30M		
9	Mounting plate	H3730131		DIN 1725 AlMgSiPb	1
4	Cable gland	T00006	PG13.5 6-12MM	PA 6	4
5	Blanket plug	T00005	ECDEP 13.5	PA 6	3
6	Jam nut	T00007	ECROU PG13.5	PA 6	4



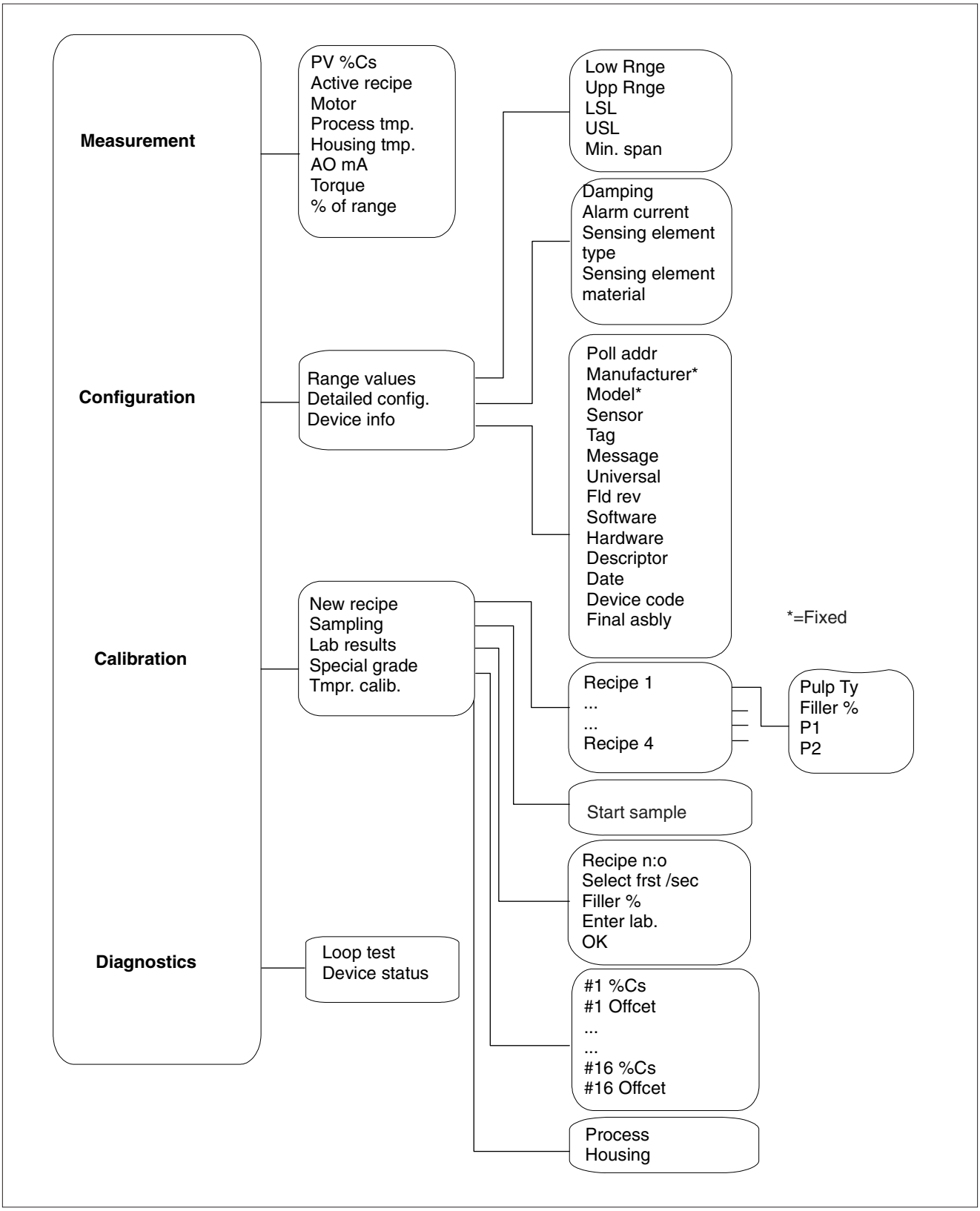
Closing flange:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
	Closing flange	T00564	J (PN10/150 lbs)	AISI 316	1
	Closing flange	T00565	L (PN25/363 lbs)	AISI 316	1
	Gasket	T00595	Closing flange	Garlock IFG-5500	1

Tools:

Part no.	Description	Order Code	Description_2	Material / Info	Pcs
	Hart modem	235641	RS232 IF		1

Appendix 4 - HART® interface



	Check list for kajaaniROTARY installation	Date
metso automation	Mill name	1.4.2005
	Process Area	Handled by
	Description of application	

Process data	min.	normal	max.		NOTE
Consistency				%Cs	
Pressure				bar	
Flow velocity				m/s, l/s	
Process temperature				C	
Dilution water temperature				C	

Process line data		NOTE
Pressure rating		Measuring chamber for PN25 not available
Pipe diameter		
Screened/unscreened pulp		
pH		
Corrosive medium present		If yes, what medium ?
Pipe wall thickness		
Pipe Standard		DIN / JIS / ANSI
Transmitter material		
Vibration		
Build up risk (pitch)		
Installation		pick one from next sheet (A…J)
Material certification requested		yes / no
Enough free space for installation		yes / no (details in next sheet)

Sealing water data		NOTE
Pressure		
Flow		min. 0.5 l/min

Electrical data		NOTE
Motor voltage / connection		star / delta
Operating frequency		50Hz or 60Hz
Enclosure class		IP55 or IP56 (optional)

Pulp grades and ratio at measuring point									
	Mechanical pulp %			Chemical pulp %				Recycled pulp %	
				bleached		unbleached			
Grade	TMP	(B)CTMP	GW	HW	SW	HW	SW	DIP	OCC

Fillers						Other chemicals or materials	
Grade	Ash %	Clay	$CaCO_3$	TiO_2	Talc	Name	%

If kajaaniROTARY replaces existing rotating transmitter or uses existing coupling, please check out the reasons of replacement !

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Documentation: Päivi Piirainen

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